EDITORIAL

An Anniversary Retrospect

The first issue of "Iron and Steel of Canada" appeared in February 1918, almost coincident with the formation of the Iron and Steel Section of the Canadian Mining Institute, and the enlarged character of this issue is intended to mark our third anniversary, and also to present to the members of the Iron and Steel Section, on the occasion of the Annual Meeting of the Institute in Toronto, a partial survey of the present status of the iron-trades in Canada.

Two years ago, the iron and steel industry in this country, impelled by war, was approaching the peak of production, and, although the trials of the Spring of 1918, and the sudden reversal of our fortunes that so quickly followed, were yet to come, the urgency of munitions production had already lessened, and our works were preparing for peace time production.

It is now almost sixteen months since the Armistice became effective, and if we take into consideration the extent of Canadian steel production in 1913, namely, 1,129,000 short tons, allow for the extraneous and extraordinary impulse of the war as shown in the record tonnages of 1917 and 1918—1918 steel production reaching 1,873,000 tons—and look at the prevailing conditions of the trade after more than a year of quasi-peace, it will be seen that reasons for solid satisfaction are not wanting. The steel production of 1919 reached only 920,000 tons, but the rate of production, if continued throughout 1920, would give tonnages as large and perhaps greater than those of the record year 1918.

There is of course still remaining a good deal of artificiality about trade conditions. Much of the present insistent demand for steel now being made upon Canadian mills by Canadian users is the reflex of the coal and steel strikes in the United States, and of the disorganization of transportation that was a secondary but very lasting result of these strikes, and is also not unrelated to the administration of the railways by the United States government.

The long deferment of ordinary replacement expenditures on the railways in both Canada and the United States, both in maintenance of way material and rolling stocks must very shortly be made good, and the purchasing boards of railways everywhere will be wise if they rid themselves of the obsession that prices of railway material will decline in the visible future. There are far more reasons to anticipate an increase in iron and steel and all structural materials than any decline, and this for causes of supply and demand, entirely unrelated to currency influences. The recent notable increase in the unfilled orders of the United States Steel Corporation indicates that the peak of steel demand has not yet been approached.

The average tonnage of steel rails rolled in Canada during the seven years 1908-1914 inclusive was 420,000 tons per year. For the four years 1915-1918 inclusive it averaged only 132,000 tons annually. No one would suggest that we have finished building railways in Canada, not to mention deferred replacements of track.

A help to Canadian manufacturers is the wholesome and natural corrective of the exchange rate, which is daily erecting a more insurmountable barrier to importations of United States' steel products into Canada, and to that extent assisting Canadian producers.

The other side of this question is, of course, the deterrent to Canadian exports to Europe, but until Canada supplies itself with steel and iron—which it has never yet done—export trade is not the question of supremest importance, although not by any means to be despised or neglected.

In any consideration of the iron and steel trades of North America, the one fact that stands out in the significance to our own country is that the total output of steel in Canada, greatly as it was increased under the imperative impulse of our recent national extremity, has not yet equalled the importation of steel and iron products into Canada in 1913, when we paid out $145,226,000 for products totalling 1,890,000 tons.

To be completely self-supplying in all grades of iron and steel is, we submit, a modest and eminently proper objective for Canada. Anything less is tantamount to a confession of national insufficiency.

THE improvement in working equipment, and in the financial strength of our steel concerns, is a noteworthy feature of the period covered by this retrospect.

The columns of this periodical have contemporaneously recorded the installation of new equipment in Canadian steel plants, and other instances are included in the present issue.

We have reason to believe that the scope of the future extension of Canadian steel plants will shortly exceed recent expenditures.

Among the extensions already alluded to in "Iron & Steel of Canada" may be mentioned those of new coking plants, refractory brick-making plants, structural-steel mills, tinplate-mills, ship and boiler-plate mills, and plants for the manufacture of steel railway-tires, and a very considerable variety of synthetic steels.

Among the announced or probable extensions are those of the Algoma Steel Corporation's structural-steel equipment, a new-plant for the Steel Company of Canada, a large-scale plant for the manufacture of silica brick for the Dominion Steel Company in Sydney, and the extensive program which is officially announced to be contemplated by the Nova Scotia Steel and Coal Co. There is also the less definite possibility of iron-smelting and steel manufacture in British Columbia, and the long-heralded extension of the United States Steel Corporation into the Canadian field at Objibway, which is announced to include a plant with twelve blast furnaces.

In this connection, it may be pointed out that although the steel production of Canada has much exceeded the tonnages of 1914, the pig-iron capacity of the country is not markedly increased.

STEEL shipbuilding is a subject of the greatest importance to our steel industry, being in fact a usual and logical outgrowth of steel manufacture in a nation possessing long seaboards.

The policy of the Canadian Government in fostering shipbuilding is courageous, but very wise, having already justified itself; and should it be followed up by an equally wise and courageous policy to deepen the St. Lawrence routes and give access to the Great Lakes for ocean-going vessels, the permanence of the coal and steel industries in Canada will be assured as they can be in no other way. Should Canada become a maritime country for half its inland extent, as would be the result of such a policy, we could reach that much to be desired state of independence in coal and iron supply that some people laugh about, and other people pray for.

The ability of any country to excel in maritime commerce is to be doubted unless that country can build steel ships out of its own resources, and steel shipbuilding must always be a precarious and artificial industry unless based upon internal resources of iron and coal. This is why British Columbia so ardently desires a steel industry. The possession of coal and the accessibility of an iron-ore supply is what assures stability to the shipbuilding industry in the Maritime Provinces, and it suggests that the measure of permanence of the shipbuilding industry in the Great Lakes is their accessibility to the Atlantic Ocean, associated as this would be with the widening of the zone of distribution of the bituminous coal of Nova Scotia.

Insofar as there is any tendency for combination between coal, steel and shipbuilding concerns, it may be taken as a healthy sign, and as probably the surest indication of permanence in all three of these basic, related and indispensable activities of a self-contained, independent maritime nation.

THE expressed opinion of the leaders of the steel industry in Canada is uniformly optimistic, as our readers will note from the official statements contained in this issue, and it may be conceded that never in our history were the reasons for optimism more sound, if a record of successful production during war time, and a quick adaptation to peace time requirements are to be regarded as indications of the resourcefulness of those who direct the steel industry in Canada—as, of course they are so to be regarded, particularly when it is remembered that six months ago the signs of the times were not clear.

THE technical progress of the past few years in iron and steel circles in Canada has chiefly been in connection with new equipment designed to effect economics in coal consumption, and during the war period there was a considerable use of electric ffurnaces for the melting of steel scrap. The more general use of electric furnaces in the manufacture of alloy-steels and ferro-alloys is a significant indication of the direction in which the most considerable progress in Canadian metallurgy is likely to be achieved in the future. The important nature of Dr. Stansfield's communication in this issue will be noted by our readers, as will also the fact that metallurgical history is being made at McGill University. Canada's coal insufficiency adds importance from our point of view to every new development of metallurgy that promises the lessening of our dependence on a coke supply made from accepted grades of metallurgical coal, and in this connection Mr. Wotherspoon's article on pulverized coal has special interest.

THE feature of the outlook that is least encouraging our dependence on the United States for coal supply. This is probably the most exigent problem of Canadian state policy. There are ways and means—if the problem is appraised from the angle of national defence—to lessen the handicap of the central provinces in regard to bituminous coal supply. The problem is not one of the steel industry only, for it cuts across our whole national life and future, but it applies with particular emphasis to the steel industry because it is so vitally concerned with fuel supply and fuel costs.

Fuel costs are probably the chief pre-occupation of steel executives today, and are likely to continue so to be.

Misplaced Parsimony

Six members of the Canadian Geological Survey have resigned and taken service with a private corporation. They could do no other, as the salaries allotted to them under the revised classification of Civil Service rates were ignominiously insufficient, and the prospect before them was for an indefinite continuance of a scale of remuneration inadequate to enable men to assume family ties; calculated to kill both the joy of life and all reasonable ambition in men dependent for relief upon a hidebound parsimony that has its roots and genesis in the utter inability of the general public to understand the value of technical men to this country.

Every one of these men was a specialist in some field of the economic geology of Canada, and quite irreplaceable.

One of the geologists who has resigned has a unique knowledge of the mineral resources of the Canadian Arctic, and has specialised on the platinum and precious metal resources of Northern British Columbia.

A second man has achieved an international reputation in the scientific classification of road materials.

An intimate acquaintance with the immense coal deposits of Alberta is possessed by a third man.

Another scientist of established reputation possesses a unique knowledge of the iron-ore resources of Eastern Canada and Newfoundland, and has for some time been working on the desperately neglected problem of the coalfields of Nova Scotia and their stratigraphic relations.

Other men include a geologist who has specialized in the combination of physiography with map-making preparatory to undertaking a study of the placer goldfields of Canada, and is now completing a report on two important gold areas of Canada. A summarisation of the work undertaken by the officers who have resigned from the Survey will disclose that they have a special and most valuable knowledge of our precious metal resources, of Canada's coal, iron and copper; of our roads, and of oil resources. There is no necessity to point out to thinking readers our national need of these materials at this time, nor to state that if these men are worth good salaries to private corporations they are worth at least living salaries to Canada. It will surely not be suggested that Canada should ask the Rockefeller Foundation to supplement the salaries of our technical civil servants to enable the country to retain their essential services, but, if the viewpoint of those who have determined the classification is to be believed, this is the only course, as we have been gravely told that the country will not stand for adequate salaries.

It may be taken for granted that the country will stand for anything that it considers really necessary, and, as the technical civil servants will, both from their natural modesty and their rules of professional etiquette, remain inarticulate; it is necessary for those who control and administer the private operation of our natural resources in basic industries such as this periodical strives to represent to speak their minds as to the necessity of retaining in Canada those men who have by long years of study and observation peculiarly fitted themselves to unravel the complexities of our ore bodies and to indicate the possible source of mineral bodies as yet undiscovered.

The value of the technical servants of the Government increases with length of service and with the accumulation of the knowledge that is the result of long-continued observation and record. The geologist in particular, is heir to all the labours of his predecessors, the result of which is communicated to him orally, and by actual demonstration in the field, as well as through the ordinary channels of technical learning; but he is also the possessor of much knowledge that is new, and extensive in the ratio of his length of service and the opportunities that he has been given for observation while in the country's service. If a geologist leaves the Survey and goes to another country, Canada loses all that he has learned of our geological deposits, all the nascent theories that might some day be developed to tangible economic advantage, and the brains that have been trained for the express purpose of assisting in Canada's development. If it should be that Canada cannot afford the remuneration necessary to attract and retain good men we must even be content with mediocre results, but, in that event let us cease talking about our wonderful country and its great future, because we shall lose our young men to the upbuilding of some other country—and shall deserve the fate of the mediocre, the timid and the second-rate.

THE APPLICATION OF PULVERIZED COAL TO IRON BLAST-FURNACES.

Our readers will be quick to see the implications in Mr. W. L. Wotherspoon's article, contained in this issue, giving details not previously published of the progress that has been made in the application of pulverized coal in substitution for coke in blast furnaces. Mr. Wotherspoon's connection with the Garred-Cavers Corporation has given him exceptional opportunities to judge of the possibility of using pulverized coal in iron blast-furnace smelting based upon its employment in the smelting of non-ferrous ores.

Mr. Wotherspoon's article appears to suggest that low-grade non-coking coals might someday be used in smelting iron-ores, which would to that extent relieve the handicap of districts where such inferior coals are all that is obtainable locally. Professor Fernsides has recently pointed out the rapidly dimin-

ishing reserves of coking coal in Britain, and has undertaken to predict the approximate date when this shortage will definitely limit the production of pig-iron in Britain under present practice.

Mr. Wotherspoon's article forecasts the not remote possibility that blast-furnace men may have to consider some revolutionary departures from traditional practice.

THE meeting of the National Slag Association of the United States, recently held at Cleveland, is said to have represented ninety per cent of that country's commercialized blast-furnace slag. The object of this organization is to bring recognition to blast furnace slag as a standardized concrete aggregate in all classes of construction, a good macadamizing material, and a desirable railway ballast. Slag is one by-product of Canadian blast-furnaces that has not been made of commercial value to any notable extent, and, on the other hand, the disposal of slag involves very heavy expenditures in labour of handling, and in the purchase of sites for dumps.

APROPOS of the suggestion that has been made in these columns on several occasions that there was an opening for a domestic cutlery industry in Canada, we are pleased to learn from Mr. Geo. Spence, the Sales Manager of the Steel Company of Canada, that this enterprising concern has supplied to Canadian manufacturers, for the making of knife blanks, steel that is regarded by these customers as being of superior quality for their purposes to special cutlery steels formerly received from Sheffield, and latterly from Pittsburgh. This goes to bear out our statement that we have in Canada "every natural requirement for the making of high-class tool and cutlery steels." After all, the manufacture of steel of any given quality, for a specific purpose, is only a matter of knowledge of proper components and temperature control.

MINING SOCIETY OF NOVA SCOTIA DEPLORES INADEQUATE SALARIES PAID TO GEOLOGISTS.

At a recent meeting of Council of the Mining Society of Nova Scotia the following resolution was adopted and forwarded to Ottawa:—

"It has come to the notice of the Council of the Mining Society of Nova Scotia that owing to the inadequate salaries paid by the Survey and Mines Branch of the Geological Department, some of the staff have been forced to resign. In the interest of the mining industry we wish to protest against the scale of salaries now being paid to such highly trained technical men whose services to the country are of such value. We would urge that steps be taken immediately to make the salaries paid sufficient to attract and retain for the service a class of men of the standard formerly associated with the work of the Department."

OBITUARY.

Captain David Kyle, M.C.

We regret to publish the announcement of the sudden death from pneumonia, following influenza, of Captain David Kyle, M.C., Vice-President and a Director of the Algoma Steel Corporation, at the early age of thirty-six years.

Mr. Kyle was born in Scotland, and came to the Sault in 1910 as engineer in charge of the construction of the Merchant Mill, and was later in charge of the erection of the gas engines. When that work was completed, he joined the staff of the Steel Plant, and was placed in charge of maintenance.

In 1912 he was made General Superintendent of operations, and in the Autumn of 1914 left the service of the Company to go overseas, where he won the Military Cross. In 1917, by special arrangement with the military authorities in London, Captain Kyle was allowed to return to Canada, and again take his place in the Executive Offices of the Steel Company. Two years later, when Mr. Franz came back to the Sault from Cleveland, Captain Kyle was elected a Director and made Vice-President of the Company.

Captain Kyle has no relatives in Canada.

The regard in which Captain Kyle was held by his business associates and the officials of the Algoma Steel Corporation, is a sufficient testimony to his engineering ability. He was an ardent sportsman, and took a lively interest in the local football and cricket matches.

METALLOGRAPHY CLASSES AT McGILL UNIVERSITY.

The series of ten lectures given by Messrs. Roast and Pascoe as an extension of the activities of the Department of Metallurgy of McGill University have now concluded. These lectures have afforded much information and help to the students who attended, most of whom were actually engaged in some branch of the metal-working industries, and contemplated adding to their duties the microscopical study of the internal structure of the metals with which they have to deal with from day to day. The course covered the theory of the grain structure in metals, the study of temperature curves, and actual practice in the preparation of metal samples for microscopic examination, ending with instruction in micro-photography.

The course was an excellent introduction to the comparatively new science of metallography, and it is anticipated, if sufficient applications are made to the University authorities, that the lectures may be resumed next Winter, progressing from the point reached in the introductory lectures.

Messrs. Roast and Pascoe are to give a joint lecture and demonstration before the Montreal Branch of the Society of Chemical Industry in the Engineering Institute Building, Montreal, on February 20th, dealing with the active life and structure of metals. The excellent examples of micro-photographic slides in the possession of the lecturers, and their intimate investigation of a wide range of metals and alloys, promise to make this evening a noteworthy one in this season's meetings of the Society.

Production of Iron and Steel from Canadian Resources

By ALFRED STANSFIELD, D.Sc., F.R.S.C., Professor of Metallurgy of McGill University.

The large scale iron and steel industry of this country is only about twenty years old as it was inaugurated with the building of the Dominion Plant in Sydney about the year 1900. Government aid was needed for bringing about this advance and the action of the Government has been fully justified by the services to the country and to the Allies of the Canadian iron industry during the war.

The production of pig iron has grown to about one million gross tons yearly, but only a small part of this is obtained from Canadian ores, and even the fuel needed is imported in part from the United States as a large proportion of Canada is unprovided with the coking coals which are essential for blast-furnace operation. In view of this condition and of the large amount of water-power in Canada, the electric furnace has often been considered as a possible solution of the difficulty.

So long ago as 1903 when electric smelting was in its infancy, Dr. Haanel, conducted a Government Commission which investigated the development of electric iron-smelting and steel making in Europe, and in 1906 with the help of the late Dr. Heroult he made a test of the electric smelting of iron ores at Sault Ste. Marie. This test was quite satisfactory from a technical point of view, and was followed by developments on a larger scale in California and in Sweden. Electric smelting in Sweden has attained to regular commercial operation, but in Canada, which resembles Sweden in many respects, the electric smelting of iron ores has never been undertaken on any important scale.

The main cause of this is the somewhat high cost of electric smelting as compared with the production of pig iron in the blast furnace. Even in Sweden the industry depends on the high price that can be obtained for electric-furnace iron reduced by means of charcoal from the unusually pure Swedish ores. This price can be obtained in Sweden because there is a considerable market throughout Europe for iron of special purity, but in Canada, the market for such iron would be very limited.

The high cost of the electric smelting of iron ores is mainly due to the large amount of electrical power that is needed this being three or four times as much as for the simple melting of steel scrap. It is this difference in power requirement thhat renders electric smelting unprofitable, while the electric melting of steel scrap was carried out on so large a scale in Canada during the war.

The writer has realised for a long time that the greater part of this electrical power could be replaced by ordinary fuel without losing the advantages of the electric smelting method, as the iron ore could be converted into a metallic powder by an operation at very moderate temperatures in fuel-fired furnaces, and this powder could then be melted cheaply in electric furnaces for the production of iron or steel. In March, 1918, he explained this idea to the Metallurgical Committee of the Advisory Research Council and asked for funds for an assistant to conduct experiments on the reduction of iron ores at moderate temperatures, as metallurgical books contain very little practical information on this subject.

The research was started at McGill University in January, 1919, and is still in progress. The results already obtained in these experiments, and information received from others who are working along similar lines, have convinced the writer that commercial success may be expected, and it appears that a means will thus be found for utilizing many Canadian ores with the aid of water-power and low grade fuel, and that material expansion of the Canadian iron and steel industry should ultimately result from this development.

Progress in the Use of Pulverized Fuel in Blast Furnaces

By W. L. WOTHERSPOON.

The use of pulverized coal in blast furnaces and cupolas for the melting of metals and the smelting of ores has met with encouraging progress since the important practical work carried out by Mr. U. A. Garred in 1913, in the melting of blister copper, followed later by the application of the Garred-Cavers process to the smelting of copper and copper-nickel ores, which experimental and development work was conducted at the smelters of the Tennessee Copper Company, Copperhill, Tenn., and The International Nickel Company of Canada, Limited, Copper Cliff, Ontario.

The details in connection with the work referred to are given in the Transactions of the Canadian Mining Institute, Volume 22, 1919, in a paper contributed by Mr E. P. Mathewson, and Mr W. L. Wotherspoon.

Great interest was taken by metallurgists in many parts of the world, as the fuel conditions existing at many smelters have been such as to interfere greatly with production, and the substitution of a considerable portion of the coke by pulverized coal offers many advantages.

More recently experiments have been carried out with the process at the smelter of the Cerro de Pasco Copper Corporation in Peru; the results being such that it is expected under the conditions existing there that fifty per cent, (50%) of the coke will be replaced by pulverized coal, being obtained from the Company's own mine in that district

The Cerro de Pasco Copper Corporation have in progress designs for a complete new smelter which will consist of blast furnaces and reverberatory furnaces, in both of which pulverized coal will be used

To Mr. W. J. Hamilton, Consulting Engineer of the Cerro de Paseo Copper Corporation, should be given credit for the encouraging results obtained from tests made at their plant, and under his recommendation the Company have contracted with the Garred-Cavers Corporation for a license to use the process.

More recently the process has been applied to smelting of lead ores and for several months has been operating continuously at the Midvale plant of the United States Smelting, Refining and Mining Company, Midvale, Utah, where about thirty per cent (30%) of the coke is being replaced by pulverized coal.

Mr. E. H. Hamilton of this plant is an enthusiastic supporter of pulverized coal in blast furnaces and should be given credit for pioneer work in lead smelting. Experimental work carried on under his supervision has met with such success that he feels there is no doubt of it being adapted to lead smelting. Careful records kept over two or more months substantiate this claim.

In addition, the American Smelting and Refining Company have at their Garfield plant a standard blast furnace in use trying out the process in the smelting of copper ores, the percentage of fuel replaced also being about thirty per cent (30%). These results are being obtained with normal blast pressures, with practically no modifications to the standard blast furnace.

The output and general operation of this furnace is as good as the other furnaces run under normal condition. The careful records kept of the experiments performed at this plant are found to be encouraging for the continuance of the process.

It would appear that with the successful application of this process to a variety of non-ferrous ores, that the chances of success in extending the process to the iron industry are deserving of consideration. It is admitted that the chemical problems in the smelting of different ores vary considerably, this being particularly so in the iron blast-furnace, but it is also evident that combustion of pulverised coal of various degrees of quality can be controlled so as to give results that might be of considerable advantage, and if it should be that only a small percentage of the coke were replaced in the iron blast furnace, the benefits obtainable from an economic viewpoint would be great. For instance:

Comparative tests in the smelting of copper-nickel ores give the following results:

		No. 7 Furnace Coal & Coke	No. 8 Furnace Coke only
Ore	tons.	2802	3023
Charge	,,	3013	3188
Coke	,,	225	411
Coal	,,	192	
Total Fuel	,,	417 — 13.8%	411 — 12.9%
Fuel cost		$4,869.00	$6,370.00
Fuel cost per ton ore		1.74	2.11

The cost of grinding the coal and the extra labor connected with the coal feeders would be about $1.07 per ton of ore which would make the fuel cost per ton of ore for No. 7 Furnace, operated with the fuel combination, $1.81.

It has been suggested by able authority that it would be beneficial to introduce pulverized coal directly into the iron furnace through the tuyers. In experiments with pulverized coal there has been established at different plants certain facts that a few years ago were considered out of the question; that is, coal does not require a certain definite space per pound to satisfy combustion, but, on the contrary, combustion can be had in a confined space under pressure as well as in large spaces under atmospheric or minus pressure, such as the conditions under which boilers, reverberatory and other types of metallurgical furnaces operate.

This fact gives encouragement to blast furnace work. The ability to substitute practically all the coal for all the coke in one furnace and to run two others on six per cent (6%) coal and six per cent (6%) coke, and to run one lead furnace with 1/3 of coke replaced with pulverized coal is gradually bringing out the merit of pulverized coal as a blast furnace fuel. In these experiments it not only has been established that finely-divided fuel can be burned in the small spaces between the ores in a shaft furnace, but beneath a molten mass of slag, ore, or metal, with either a reducing or oxidizing flame.

These developments promise to have an important influence in metallurgy, and causes one to believe that iron furnaces hold a great future for pulverized coal. The flexibility and easy control contributes to its success in no small measure. The great difficulty heretofore has been the application. The present adaptation for smelting copper-nickel and lead ores will naturally induce those interested in iron to think of the possibilities in that field of work. It does not necessarily follow that the fuel must be coke and must be put in at the top of furnace, because it has been the practice; there are good reasons to believe that coal dried, pulverized and properly applied to an iron blast furnace can be substituted for a portion of the coke new used. The following points are pertinent and have been suggested:

1.—The cost of fuel will be smaller, because the coke is partly replaced by the much cheaper coal

2.—The production of ferro-silicon, ferro-manganese, ferro-chrome, etc., will be made easier, and with ferra-manganese there will be less loss of manganese in the slag.

3.—The top temperature will be lower, because less fuel will be added with the charge.

Figures 1 and 2 illustrate the vortex tuyere and a small combustion chamber or enlarged tuyere, together with the method of applying same to a blast furnace. These have been designed to guarantee the full pressure of air at each tuyere and to act as an igniter for the coal as it enters the furnace.

The nozzle shape of air duct through the tuyere holds the air pressure at this point about the same as at the blower (provided the blast main is large enough). This brings within the tuyere primary and secondary pressures; the primary being that of the blower side of nozzle and secondary the furnace side of nozzle. This is found necessary to take care of the change of conditions in the furnace caused by blow holes; sliding and settling of the charge. Any small obstruction to a single tuyers will be overcome immediately by the pressure building up and relieving itself. There we have a safety device against backward flow of coal or back blast into tuyers pipe. The ball valve furnishes a means of punching the tuyers without coal escaping into the room as it is so arranged that the rod passes through the clean air nozzle, through the vortex chamber where the coal is admitted and from there into the furnace. The air press-

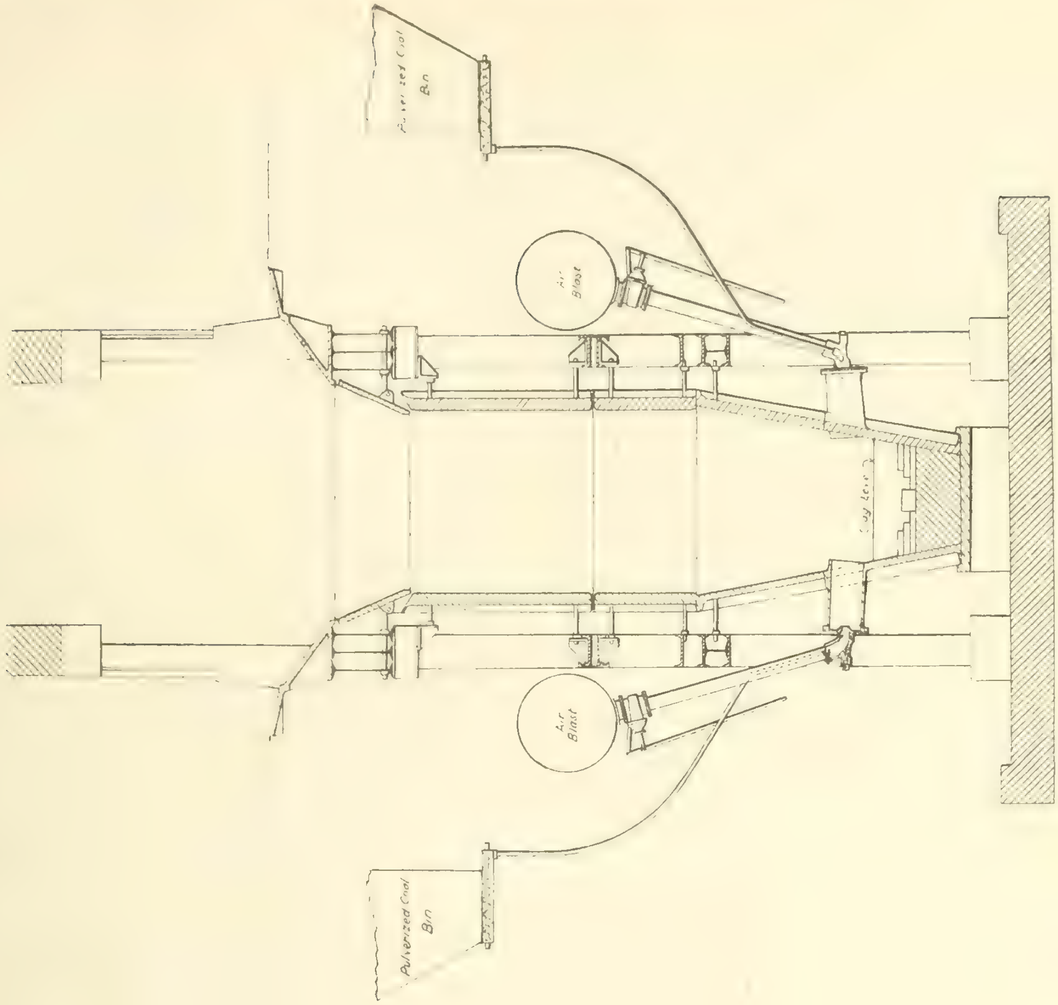
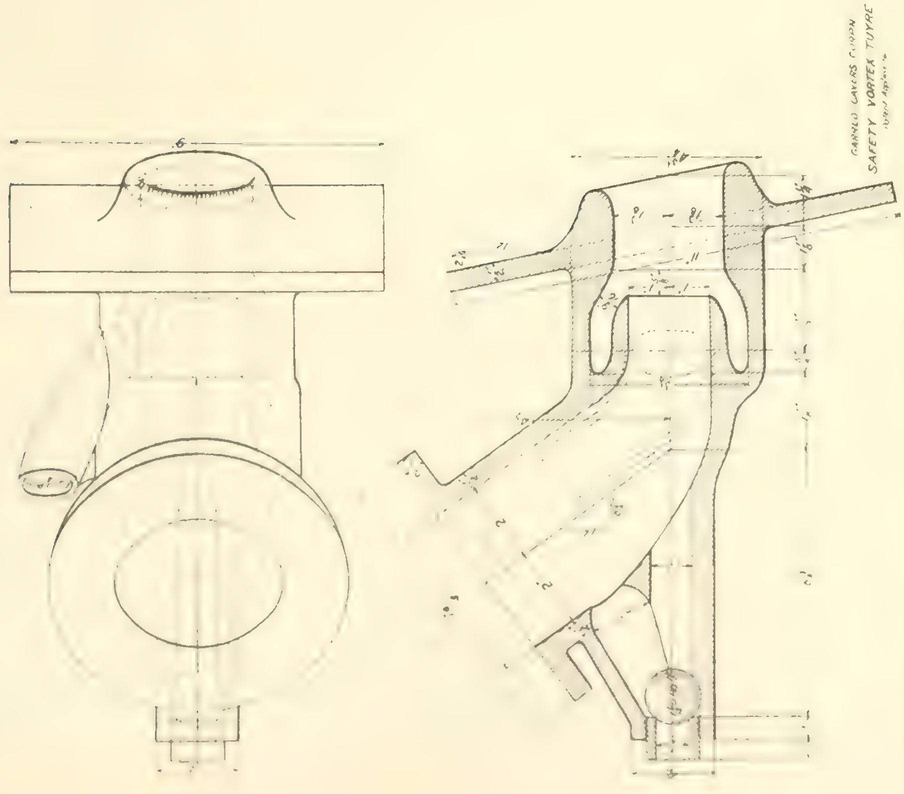


Fig. 2—Method of applying Pulverized Coal to Blast Furnace



Fi... Vortex Tuyere, and adaptations of Tuyere to form Small Combustion Chamber

ure of the furnace always being less than in the nozzle, the coal flows into the furnace, allowing only clean air to come out around the punch rod. The small combustion chamber is lined with a high refractory substance and is kept white-hot by the coal igniting in it. This serves a double purpose, i.e., preheating the air before it enters or comes in contact with the charge and holding the smelting zone near the tuyere. The combination of these points should make a blow torch action at each tuyere, maintaining rapid smelting at this part of the furnace.

WELFARE WORK AS A FACTOR IN THE LABOR PROBLEM.

By A WORKS OFFICIAL.

The administration of industrial organization today embraces more than the cost of production and selling prices, and despite the first-class equipment and good organization it is very evident that "capacity production" will be an unknown quantity until the workman is considered as a producer in relation to his home and living conditions, as he is now considered in relation to industry. Whether or not a man shall do an honest day's work is as much a matter of his home surroundings and the interest taken in him by his employer as far as these home surroundings are concerned, as it is a matter of his physical strength and skill. His attitude toward his work each morning is determined largely by his living conditions and the environment of his home. From what has been written by men who have made a special study of welfare work it is clearly proven that the company which is most successful with its labor is the one which differentiates between the mechanical and the human factor as far as its workmen are concerned.

"Welfare work," or whatever name humanitarian endeavor may go under, should be of such a character as to influence the workman to a co-operative interest in his work, make him feel that his home is something more than a place to sleep in, give him something interesting to do in his leisure time that will not lower his efficiency as a workman, and make him feel generally that he is a necessary member of the community.

No fixed rules can be formulated for the development of welfare work. They will have to be worked out on lines that will apply to each community or district. The work must be non-sectarian, institutional and of such visible importance as to command the respect of the community. Whatever the institution, its influence must not only reach the men, but the women and children, and therefore the home.

Nothing paternal, selfish nor mercenary should be attempted as failure will be the sure result. A broad common-sense view must be taken of the matter and all question of sectarianism eliminated. Officiousness should be shunned like the plague.

It may be fundamentally stated that it is quite impossible to work out any scheme of helpfulness on the part of the employer unless the employee himself sees the need of it and feels that he is really the author of the plan. No machine-made organization should be started with the idea of forcing it upon the men.

The ideas of betterment should come from the workmen themselves, and although this may be a slow process, and it may very often be necessary to go around the back way to plant these ideas, lasting results will be attained. Of course, all kinds of ideas will be suggested, some of them wholly impossible. but it will be for the person in charge of the work to segregate the reasonable from the unreasonable ideas and place them before the management for their decision in the matter. Some of the sociological activities of the larger coal companies in the United States are as follows:

Community houses have been erected by the companies; athletics of all kinds are encouraged; sewing and cooking classes for women are held at stated times in the Community Houses, and qualified instructors for these classes are paid by the companies; kindergartens are started for the small children; community musical organizations are formed from among the different nationalities working in the mines; adult bands and boys' bands being a part of the musical organization. Playgrounds are provided and especially fitted up for the encouragement of sports of all kinds and particular attention is paid to provide gymnasium apparatus for the use of the children. Red Cross clubs and classes in First Aid are instituted and the reports show the results have been most satisfactory.

Religion and politics have been left to the workpeople themselves to do as much or as little with as they chose, all being assured that the right was theirs to have as much or as little of any particular brand as they had need for.

The recognition of the human factor in industry in whatever form is bound to become more important as labor conditions become more acute. This is especially true where a large number of foreigners are employed.

Note.—This expression of opinion is chiefly interesting because it proceeds from an official who in his time has had probably a more extended and intimate acquaintance with the employment problem than any other corporation officer in Canada.—Ed.

THE MINING SOCIETY OF NOVA SCOTIA.

The Annual General Meeting of the Mining Society of Nova Scotia is planned for May 4th and 5th. and will be held in Glace Bay.

The new officers for 1920 have been nominated as follows:

President: A. J. Tonge, General Superintendent of Dominion Coal Company.

First Vice-President: Geo. D. MacDougall, Chief Engineer of the Nova Scotia Steel and Coal Co.

Second Vice-President: Charles M. Odell. Resident Engineer of Dominion Coal Company.

The retiring President is Colonel Thomas Cantley. Chairman of the Board of the Scotia Company.

Arrangements are being made for excursions to the collieries and to the neighbouring steel works.

This is the first time that the Mining Society's Meeting has been held in the colliery town of Glace Bay. The Dominion Coal Company will place its Officials Club Rooms, and the Committee Room at the disposal of the Society for the meetings.

Later announcement will be made of the programme and papers.

The International Nickel Company of Canada

The history of the nickel industry in Ontario dates from the incorporation of The Canadian Copper Company in January 1886, by S. J. Ritchie of Akron, Ohio, and some business associated from Cleveland, Ohio.

The original holdings were acquired by Mr. Ritchie in 1885 from prospectors, who had been prompted in their search by the exposure of ore in a rock cut at Murray Mine near Sudbury, during the construction of the Canadian Pacific Railway, then recently completed through that district.

The early discoveries were taken up for copper only, the presence of nickel not being suspected, hence the inappropriate name "The Canadian Copper Company".

In 1888 after a good deal of preliminary investigation, a smeltng plant with one small blast furnace was built at Copper Cliff, and the product, in the form of matte, shipped to the Oxford Copper Company, who operated a refinery at Bayonne, N.J.

When the first smelter was built in 1888, three mines were in operation, namely: Copper Cliff, Evans and Stobie. These continued to supply the major part of the ore requirements until about 1899. No. 2 Mine was opened up in 1898 and Frood or No. 3 Mine in 1900; several other deposits, such as McArthur,—No. 1, No. 4, No. 5 and No. 6, having been opened up and abandoned in the meantime.

In 1901 the construction of the Manitoulin and North Shore Railway (now the Algoma Eastern Railway) from Sudbury to Gertrude Mine provided an opportunity to develop Creighton Mine, which soon proved to be a very extensive ore-body.

This brings us to the formation in 1902, of The International Nickel Company, which combined The Canadian Copper Company, operating mines and smelter, with the Oxford Copper Company, operating the refinery, the former Company still retaining its name.

CREIGHTON MINE—INTERNATIONAL NICKEL CO., LTD.
SUDBURY, ONT.

It required comparatively little nickel at that time to swamp the world's markets, and it was only with the development of nickel steel and its adoption for armour plate for the United States Navy, that The Canadian Copper Company began to get on its feet.

In the meantime, from 1890 to 1894, several other nickel companies entered the field, operated for short periods and disappeared, among whom may be mentioned the H. H. Vivian Company (Murray Mine), the Dominion Mineral Company (Blezard Mine) and the Drury Nickel Company (Chicago Mine).

The Canadian Copper Company's operations however, in spite of difficulties and disappointments, continued to grow. The original (East) Smelter was enlarged from time to time until 1899 when the West Smelter was built, still using the same type of small hand-operated equipment.

The blast-furnace matte continued to be sold to the Oxford Copper Company, who, however, built the Ontario Smelting Works in Copper Cliff in 1900 to further concentrate the matter before shipment to the refinery.

This marked the beginning of an area of rapid development. Ample capital was provided; a new modern smelter was constructed, with large units mechanically operated; and the most modern mining equipment was installed at Creighton and No. 2 Mines and at the newly opened Crean Hill Mine. The Hydro-Electric Plant at High Falls was developed with its thirty-mile transmission line to Copper Cliff and branches to Crean Hill and Ceighton Mines.

Continually increasing demands for nickel both prior to and during the war have made necessary successive aditions to the Smelting Plant, until it now includes eight blast furnaces, one reverberatory furnace and six large basic converters, with a capacity of upwards of six thousand tons per month of Bessemer matte, containing 80% of combined copper and nickel. This is about forty times the capacity of the first smelter built in 1888.

No. 3 Mine was closed down in 1914, No. 2 Mine in 1917 and Crean Hill at the end of 1918; the total ore requirements being now supplied by Creighton Mine.

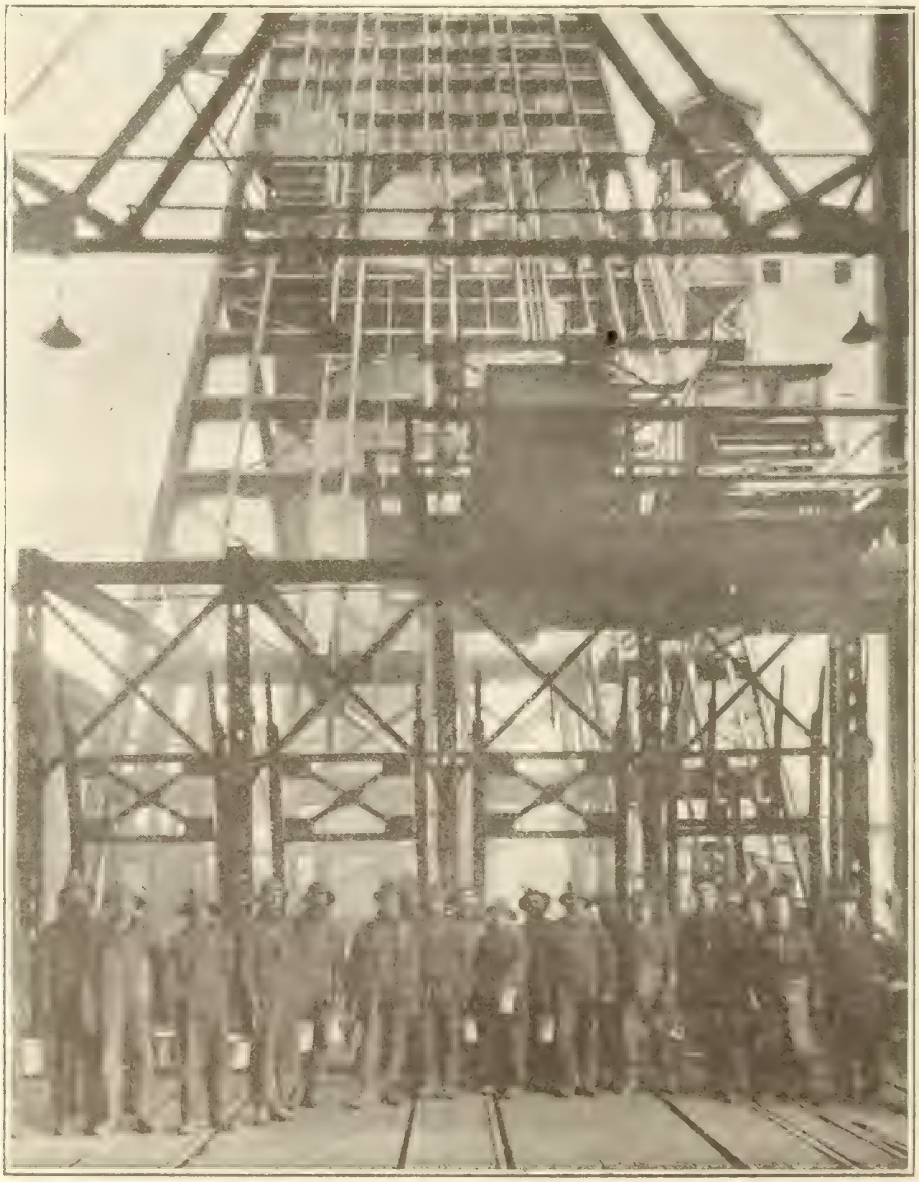
In 1916-17 a new five-compartment shaft (No. 3 shaft) was sunk at Creighton and the Mine equipped with electrical haulage, large underground crushers and loading pockets. A complete new surface equipment of the most modern type was built, including headframe and rockhouse, power house, office, change-houes, blacksmith machine and carpenter shops, supply warehouse, etc., all of steel, brick and concrete construction. The hoisting capacity is over five thousand tons in sixteen hours.

In 1916 all roasting operations were removed from the vicinity of Copper Cliff and a new Roast Yard constructed on the Algoma Eastern Railway between Crean Hill and Creighton, where a large, electrically-operated steel ore-bridge was last year installed for placing green ore on the roast beds, thus doing away with the last of the Company's large manual operations.

In 1916 The International Nickel Company of Canada, Limited, was incorporated, following which a large nickel Refining Plant was built at Port Colborne, Ontario, a a cost of about $5,000,000.00. In August, 1918, The Canadian Copper Company was amalgamated with, and is known as the "Mining and Smelting Division" of, The International Nickel Company of Canada, Limited, and the Port Colborne Plant as the "Refining Division". The Head Office is in Toronto.

The first finished product from the latter Plant was produced in September 1918, and the Plant has been runing at full capacity since that time, producing refined nickel as ingots and shot, nickel oxide and blister copper.

The Company has for many years shown a lively interest in the welfare of its employees. Eight hour shifts were inaugurated a number of years ago. A Department of Safety and Welfare is a prominent feature of the organization. A complete, modern, fire-proof hospital is maintained for the Mining and Smelting Division, with competent medical and nursing staffs. Modern recreation clubs have been built and splendidly equipped and furnished. Athletic



MINERS WAITING TO DESCEND AT THE SHAFT OF THE CREIGHTON MINE

grounds have been developed and athletic sports encouraged. The employees' stock distribution, on easy terms, have been largely taken advantage of. During the past year, free insurance under the group insurance plan has been extended to all employees of a certain standing. Most of the employees of the Mining and Smelting Division are housed in Company-owned dwellings at very moderate rentals.

Nickel for industrial use is produced in various forms, such as metallic ingots and shot, as oxides and salts, and is used for many purposes; but by far the largest use is for alloying with steel.

The earliest developments of nickel steel were in Great Britain at a time when New Caledonia nickel supplied most of the world's requirements. These experiments were brought to the attention of the United States Naval authorities by S. J. Ritchie, and tests were made by them which resulted in the adoption of nickel steel for armour plate, the first naval vessel to be so equipped being the battleship "Maine" of Spanish-American War fame in 1891; Great Britain falling into line with the Renown in 1891.

The first of this nickel steel armour plate made in the United States was rolled in the armour plate department of the Homestead Works of the Carnegie Steel Company, under the superintendence of the late E. F. Wood, one of the organizers of The International Nickel Company and for many years its Vice-President.

The wonderful physical properties of nickel steel have led to its rapid adoption for many industrial uses, particularly where the saving of weight (amounting to as high as thirty per cent.) is of importance, as in marine machinery, long-span bridges, etc.

Many special alloy steels have been developed from nickel steels by the addition of small percentages of other materials such as chromium, vanadium, tungsten, titanium, molybdenum, etc.

The Company has for many years maintained a Technical Department, including a physical and research laboratory, where many intricate problems have been worked out in the development of special grades of nickel and nickel alloys to meet definite specifications covering physical, chemical and electrical requirements, particular attention being paid to the needs of steel manufacturers.

THE SMELTER—COPPER CLIFF, ONT. INTERNATIONAL NICKEL CO.

NICKEL REFINERY OF THE INTERNATIONAL NICKEL CO. LTD. PORT COLBORNE, ONT.

Halifax Shipyards Limited

An Enterprise of First-class National Importance

By D. E. O'BRIEN, Chief Engineer.

The enterprise of the Halifax Shipyards, Ltd., which is herein described by Mr. D. E. O'Brien, the Chief Engineer of the Company is an ambitious and far-reaching one, as a perusal of the following article will disclose, but it is not more ambitionus nor more far-reaching than the future of the Port of Halifax. A steel floating-dock of 50,000 tons capacity, and the eventual building of passenger ships up to 700 feet in length is contemplated by the Halifax Shipyards, but considering the importance of Halifax, as demonstrated by the accomplishment of the port during the war period, and the probability that some day in the future it may rank in maritime importance as the second seaport after New York on the Atlantic coast; these plans are modestly and wisely conceived, and the promoters of this enterprise are to be congratulated on their farsightedness.

The site controlled by the Halifax Shipyards is one of its greatest assets, and was only made possible by the complete sweep which the Mont Blanc explosion made of this water-front district. With the new terminals of the Canadian National Railways on the North-West Arm, the building, docking and repairing facilities which the Halifax Shipyards will provide, and the land-locked harbour of refuge and assembly provided by Bedford Basin, Halifax may look forward to being truly and in very fact the "Guardian of the North," and a maritime metropolis of first-class rank.

HALIFAX SHIPYARDS -GRAVING DOCK, MACHINE SHOP AND PIPE SHOP

The plant of the Halifax Shipyards is situated on the western shore of Halifax Harbour at the north end of the City of Halifax. The property includes the area bounded on the west by C. G. R. right-of-way on the east by Halifax Harbor and on the south by North Ferry St., and on the north by C. G. R. Pier. No. 9.

Prior to the disastrous explosion of December 6th, 1917 the area on the western side of the Harbor between North Ferry St. andPier No. 9, was owned by Halifax Graving Dock Co., Acadia Sugar Refinery, The Canadian Government Railways, Halifax City, the Boak Estate and the Glassey estate. The water front consisted of the Canadian Government Piers Nos. 6, 7, 8, and 9.

The C. G. R. Pier No. 6, located near the centre of this area projected into Halifax Harbor about 400 feet in a south easterly direction from the main-land and about 200 feet from this Pier the Steamer "Mont Blanc" blew up with its cargo of T.N.T., which completely demolished all structures in the north section of the city and all the buildings and wharves along this section of the water front.

After the disaster the C. G. R. took steps to expropriate all the water front in this vicinity and it was during this period that negotiations were entered into by the present officials of the Halifax Shipyards Ltd., and the C. G. R. whereby the Shipyards Company acquired the property now owned by them.

In the Spring of 1918, an extensive survey was made and plans were prepared for an up-to-date shipbuilding yard and provision was made for future extensions. This necessitated a large amount of excavation and grading as the area, as it existed, was

HALIFAX SHIPYARDS—GENERAL VIEW OF SHIPS NOS. 1 AND 2

HALIFAX SHIPYARDS MOULD LOFT FLOOR

very unsuitable for immediate operations. The work consisted in the removing of about 350,000 cu. yds. of excavation which was to be used in reclaiming land along the water front. It was necessary that a new right-of-way should be made for the C. G. R.'s existing main lines which passed through the centre of the properties. This right-of-way had to be moved westward, to take up a space of 50 feet wide measured from the east side of Barrington St. It was from this area that the greater part of the excavation was removed. In order to hold up Barrington St., after this cutting was made it was necessary to build a heavy concrete retaining wall along the East side of the street. The difference between the street elevation and the finished grade of the main-line tracks was an average of 25 feet for a length of 2610 feet.

The present layout differs considerably from the original layout as a number of changes had to be made owing to unforseen difficulties which arose from time to time. The berths in the original design were at right angles to the shore line and three in number but were subsequently changed to their present location as it would facilitate launching; and also would allow just as much space at the head of berths, while the ends of the ways were in shallower water, which is advantageous in construction and launching of the ships.

The platers' and coppersmiths' and other shops were originally located directly in front of the berths. but when the diagonal berths were decided upon the shops were placed far enough north of No. 4 Berth. to allow for the construction of 700 feet passenger steamers. the building of which is contemplated by

HALIFAX SHIPYARDS—GENERAL VIEW LOOKING SOUTH
OFFICE BUILDING ON RIGHT

the company. All other buildings and structures are now placed in their original positions on the layout.

Access to the plant is obtained by means of two bridges over the C. N. R. tracks one of which, the traffic bridge leads to a ramp, which in turn leads to the Shipyards main gate at the north and H. M. C. Dockyard Gate on the south. The foot bridge is immediately in front of the office building, and is used, for all who live in the north end of the city to enter and leave the Plant. At the main gate a clock house 92'6" x 15'6" is erected containing 20 clocks which are automatically regulated to standard time by a master clock. The master clock is located in the Telegraph & Telephone Office and the correct time is received every day at 12.00 o'clock noon from the government observatory at St. John, N.B. The company has its private telegraph wire and private telephone system of 50 phones.

The administration building located at the main gate is 280 feet long, 50 feet wide and three stories high. Part of the lower floors of the building are used as storerooms and compressor rooms and the remainder is used for offices for the executive and other staffs. The ambulance, first-aid doctor's offices, timekeeper, employment and paymaster's offices, are on the ground floor in the south 60 feet section of the building. In the north end on the ground floor, compressors are placed which will supply air for pneumatic machinery and tools. The purchasing telegraph, telephone inquiry and traffic offices are at the main entrance. The stores office and marine engineering offices are also on the second floor. The executive accounting, engineering and drafting offices are located on the third floor. On the top floor the hull drafting office is located.

The Graving Dock, the only structure on the original properties not seriously damaged by the explosion, is 585 feet long and 100 feet wide and capable of accomodating ships 560 feet long.

The Machine Shop is built fifty feet east of and parallel to the Graving Dock. It is a reinforced concrete building 300 feet long and 100 feet wide and is equipped with 15 ton overhead crane for the handling of heavy material. A heating plant is now in the course of construction at its south end which will heat the Machine Shop and adjoining Pipe Shop by means of hot air forced through 48" metallic ducts by electric fans.

A pipe fitters and electricians shop is built at the north end of Machine Shop. The building is 90 feet long and 40 feet wide and two stories high, built of concrete and brick, and heated as before mentioned.

The platers shop is located at the north end of the property. It is of steel frame and brick construction 600 feet long 75 feet wide, 500 feet of the building is two stories high, the upper floor being the Mould Loft. The portion of the building 100 feet long at the north end is the Smith Shop and contains steam hammers, forges etc. An overhead crane-way extends along the full length of the shop. The crane of 5 tons capacity is electrically operated. At the north end of the Smith Shop a fan house is erected. All forges are down-draft and the air is exhausted by means of an electrically-operated fan. The smithy iron is stored in an angle rack at this end also. When the building was designed, provision was made for a leanto extending 500 feet in length of main building on either side. At present 340 feet of the leanto is constructed on the west sire beginning 40 feet from the south end and thence running north. It is proposed to have marking tables in this portion of the building and it is equipped with 5-ton overhead electric crane to handle the material.

At the north end of the office building the main heating plant is located. From this building a reinforced concrete trench 4 feet square conducts the steam heating and return pipes also the air and hydraulic pipes from the compressors, accumulator and heating plant to the Plate Shop, a distance of about 400 feet. Along the east side of the Plate Shop a craneway 400 feet long by 80 feet wide is constructed which spans the Plate Racks and the assembling skids. The Crane is electrically driven and of 7½ tons capacity.

The Power Plant is located at the extreme southeast corner of the Yard and is a steel frame re-inforced concrete and brick building. The boiler room is 143 feet long and 50 feet wide. The generator room is 93 feet long and 50 feet wide having a turbo generators of 40000 combined horse power., capacity with pumps and other necessary equipment, including a hand-operated overhead crane of 15 tons capacity. The chimney to produce natural draft and insure combustion, is reinforced concrete 207 feet high and 11 feet 9 inches in side diameter at the base, tapering to an inside diameter of 10'6" at the top.

A saw mill and Joiner Shop remains to be built which will be located north of the Plate Shop and will be 200 feet long, 50 feet wide and two stories high.

The change in the location of the C.G.R.main lines necessitated the building of a concrete wall along the east property line. This wall is about 1000 feet long and has an average height of eight feet. The change in the location of the C. N. R. tracks also necessitated extensive changes in the Admiralty properexisting main lines were diverted 50 feet east in order ty, immediately south of the Shipyards property. The existing main lines were diverted 50 feet east in order to eliminate curvature of grade and to connect with the track along North Street Yard. This bent the cutting of a new righ-of-way through rock from Shipyards traffic bridge to a point 150 feet south of the Dockyard gate. A number of buildings were removed and the City sewers and water lines were lowered to conform with the new grade and alignment. A new system of gas lines was necessary as the existing gas-main ran directly under the main line tracks.

At present four ships are under construction on the berths. The first two keels laid down were 8150 tons ships 400 feet long, 52 feet beam and 31 feet depth. The next two keels were for 10,400 ton ships, 430 feet long, 56 feet beam and 38 feet depth. The derrick system at the berths is complete only for berths No. 3 and 4. The system consists of 12 derricks with masts 90 feet high and booms 35 feet long, electrically operated. The derrick arrangement is such that material can be placed on any portion of the ships from material cars which are shunted down between berths.

For Berths 1 and 2 a new arrangement of derricks is proposed. It will consist of three stationary derricks spaced equally along the length between the berths. These derricks are surmounted on a steel trestle 100 feet high and have a boom radius of 90 feet with a lifting capacity of 5 tons. They are equipped with double-friction electric hoists drums 16" diameter and 30" long, (hoisting duty 7000 pounds at

?00 feet per minute, and an electric swinging engine.

The Company contemplates adding to its present equipment, a steel floating dock 50,000 tons capacity. In order to accomodate this giant dock, the water front must be deepened and anchors provided to hold the dock in place, also a sea wall constructed that material may be delivered to the craft under repairs

As rapidly as the course of construction will permit, the company propose building their own boilers and engines and all fittings appertaining to the complete construction of ships.

The plant is equipped with a modern three way sprinkler system installed by the Automatic Sprinkler Co. of Canada. The shops are equipped with the dry system, and the offices with the wet system.

A 40,000 gal. steel tank 75 feet high keeps a constant pressure on the system and an emergency fire-underwriter pump of 1000 gal. per minute is ever ready in case of emergency. The Fire Department is well organized with Fire Chief, 30 subordinates, with an extensive fighting equipment.

The housing problem has been one of deep concern for the men employed at the yard, but at present the problem is being cleared up considerably. The management has obtained a number of houses which will be sold or rented at a reasonable price to those who desire them, thus offering men comfortable homes within easy reach of their work.

The management has also bought the spacious King Edward Hotel which at present houses a number of the men with their families.

The employees have organized a social and athletis Club in the interest of the men in the yard. They have obtained the lease of the Y.M.C.A. which formerly belonged to the Dockyard property. It is used for meetings and social gatherings, which tend to bring about a "get together" spirit amongst the men. Material is available in the yard for all sporting competitions and after having a successful baseball and football team with the sanction and support of the management and men, a fast hockey team has been entered in the Dartmouth league. For those who do not interest themselves in this type of exercise, the Club affords a competent gymnasium instructor who holds classes twice each week. It is also the intention of the Club to institute night-classes so that men who have not had the opportunity in earlier days may become proficient in the various branches of work at which they are employed.

The membership of the Club is growing and the Committee proposes to have every man in the yards as a member next season when there will probably be 2000 men on the job.

HALIFAX SHIPYARDS—PLATE SHOP AND LEAN-TO—LOOKING NORTH

The Dominion Shipbuilding Company Limited of Toronto

The Dominion Shipbuilding Company, Limited, of Toronto, is a business organization that has contributed much to the development of the shipbuilding industry in Canada. Although it only came into existence in 1917, the plant has been steadily expanded and the scope of the company enlarged until in the present year the industry finds itself well abreast of the capacity of the plant and its building program, which was twelve ships per year, of canal size, 261 feet over all, with a carrying capacity up to 4300 gross tons. The 1918-19 program consisted of eight bulk freighters, two of which were delivered in the fall of 1918, three in the following spring and the remaining three at later periods. Four additional contracts were quickly got underway, the end of 1919 and the begining of the present year seeing the launching of the "T. L. Church" and the "Torontonian" respectively.

The Dominion Shipbuilding Company's plant has been constructed on fifteen and a half acres of land reclaimed by the Toronto Harbor Commission and extends from Bathurst Street on the west, to Spadina Avenue on the east, with five building-berths for canal-size ships, and other buildings, which, when the present plans are completed, will have involved an outlay of two and a half millions dollars. Practically all of the plant has been constructed now, with the exception of one or two units and these will likely be under way next summer. When the final touches are put on the works the company will have one of the best equipped shipbuilding plants on the continent. These buildings take the place of the old Thor Iron Works at the foot of Bathurst Street, which were destroyed by fire. It is to the credit of the company that during 1918 they not only built a good portion of the plant but in the same year they built and delivered six steamers. At the beginning of that year Mr. Louis Dahlgren, the General Manager of the company, having no fabricating shops, used those of the old Thor Iron Works for the preparation of the material, had it drawn over the snow by hand a distance of 300 yards to the new berth, and laid the first keel in the snow, building the first ship the "St. Mihiel," in that fashion with the help of only one small locomotive crane.

Meanwhile piles were driven through the newly deposited land which was being reclaimed, down to the rock, for the plant buildings. Work was in progress when, in the following April the Thor plant, which Mr. Dahlgren had been utilizing, went up in smoke. More trouble came in the difficulty of obtaining suitable machinery, the company being forced to subsidise certain machine shops to build the necessary machines, which, when ready, were placed in the now partly completed fabricating shop of the plant. Since then rapid progress has been made, not only in expanding the plant but in turning out the company's many contracts, until today the Dominion Shipbuilding Company is recognized as one of Canada's big and leading industries.

PANORAMIC VIEW OF DOMINION SHIPBUILDING YARDS AT TORONTO LOOKING SOUTH

At the present time the plant lacks the foundry and boiler shop, which were originally planned, but these will be constructed as soon as the company can turn its attention to them. The main building which has been in operation for a considerable length of time, takes in the furnaces, smith shop and punch shop with machinery for handling about 75 tons of ship steel per day of nine hours, while there are also departments for bending slabs and angle-iron work. The power plant, warehouse, joiners' and carpenters' shop and mould-loft are on the second storey. The entire building, which is 485 feet long and 210 feet wide, is constructed of steel with reinforced concrete walls and corrugated iron roof.

A second building takes in the electrical shop, pipe shop, blacksmith shop, machine shops and pattern shop. This building is 275 feet long and is to have another

150 feet added on; these will be 110 feet wide.

The plate and angle furnaces are of the oil-burning type and are capable of handling the longest frames and plates required. They were installed by the Toronto Incinerator Company. For handling the steel at the ship's side three gantry cranes have been installed, and there is also one set of shear legs of 100-ton capacity. These are used in the installation of the engines and the boilers immediately after launching. All machinery is electricaly driven, and alternating current is obtained from the Hydro system.

In laying out the plant every precaution was taken to lessen the handling of material as much as possible. The principle of "straight-line" operation has been followed in the designing of the lay-out so that there is no waiting of one department upon the progress of another department, and when several other units, now in contemplation, are constructed, the Dominion Shipbuilding Company will have added considerably to its already well-equipped and up-to-date plant.

The company is now located in their new Office Building, a handsome solid brick structure erected during the later part of 1919. The 1920 construction programme consists of twelve steel freighters, two of which are building for account of the Dept. of Marine. These vessels are all designed for ocean service and are building to Lloyd's highest class.

DOMINION SHIPBUILDING COMPANY, TORONTO
VIEW OF YARDS, LOOKING NORTH

INTERIOR OF PUNCH SHOP

Official Review of the Completed Program of Shipbuilding of the Imperial Munitions Board in Canada

Total of 349,163 tons of d. w. Shipbuilding in Canada

With the delivery of the steamships War Vixen and the War Magic at the port of Halifax, N. S., in January, there was completed the Imperial Government's shipbuilding programme in the Dominion of Canada, under which there were turned out 46 wooden vessels of 142,600 tons deadweight and 42 steel vessels of 206,563 tons deadweight, making a total of 88 vessels and a total of 349,163 tons deadweight.

Early in the year 1917 the Canadian delegate of the British Ministry of Shipping, Mr. James Esplen, arrived in this country and made a tour of all the existing yards and also investigated the possibilities of new shipyards then being mooted. At that time the Canadian shipbuilding industry was almost dormant, there being in existence some half dozen shipyards, which made a meagre existence by building service vessels for Government departments. Mr. Esplen acted in conjunction with the Imperial Munitions Board, under the chairmanship of Mr. (now Sir) Joseph Flavelle, which was at that time executing large munitions and other contracts on behalf of the Imperial Government. As soon as negotiations for ships were well under way, Mr. Esplen returned to England, leaving the execution of the work to the representative of the Ministry of Shipping, Mr. R. R. Gray Chisholm to act as advisor on plans and construction.

It was soon realized however that the work involved was of such magnitude that a trained staff would be required to handle it, and the result was that Colonel W. I. Gear, perhaps the most prominent shipping man in the country and vice-president of the Robert Reford Company, Limited, of Montreal one of the oldest transcontinental shipping firms in the Dominion, assumed control of the work under the title of "Director of Steel Shipbuilding." Col. Gear proceeded to Ottawa on May 7th 1917 and associated with him on a large staff were Mr. Walter Lambert, M.I.N.A., naval architect; Mr. Robert McNab, M.I.N.A., marine engineer; Mr. D. J. Hirst, accountant, and Miss C. A. Hunter, secretary.

New Yards Opened.

With the exception of one or two yards all had to make large additions and improvements to carry out their contracts, while entirely new yards were organized by the Canadian General Electric Company of Toronto at Bridgeburg, Ont.; the British-American Shipbuilding Company, Limited at Welland, Ont., and the Midland Shipbuilding Company, Limited at Midland, Ont. At first it was not intended to build other than steel vessels but as the losses from submarines made tonnage requirements more urgent, the door for wood and concrete construction was opened. A programme of wood construction was inaugurated, comprising 46 ships 19 in Eastern Canada and 27 on the Western coast, Mr. R. P. Butchart with whom was associated Capt. J. W. Troop, undertaking the building of these vessels on the Pacific coast.

Shipbuilders were unobtainable and most of the work, in fact all of it with the exception of a boat built at Liverpool, N. S., was undertaken by general contractors who had large organizations but no shipbuilding experience. Contracts were finally concluded with the following contracting firms in Eastern Canada for wooden ships such firms having to construct the yards from the foundation up, including purchase and installation of wood-working machinery to handle logs as large as 36 inches square, an enormous task in view of the fact that they had no previous experience in shipbuilding; Grant & Horne, St. John, N. B., 2 vessels; Quinlan & Robertson, Ltd., Quebec, 4; Quebec Shipbuilding & Repair Co., Ltd., Quebec, 2; Three Rivers Shipyards, Three Rivers, 2; Fraser Brace & Co., Ltd., Montreal, 4; Toronto Shipbuilding Co., Ltd., Fort William, 2 vessels. In addition the Southern Salvage Company at Liverpool, N. S. the only old yard, took a contract to build one vessel. All the wooden ships were standardized and built to a common plan.

SS. "SKOLMA," LAUNCHED AUG. 7th, 1919.
D.W. 3,550 gross tons. Steel car freighter now in Trans-Atlantic Service.
Built by Dominion Shipbuilding Co., Toronto.

Many Obstacles

Severe weather in the United States interfered with the shipment of supplies for steel vessels and when the United States entered the war, the commandeering by that Government of all wood and steel plants and their products seriously hampered the work of the Imperial Munitions Board. The operation of the conscription law took many men from the yards and labour restlessness also had to be contended with. Great trouble was also experienced in securing the necessary quantity of timber for the wooden vessels and when it is stated that altogethed nearly 70,000,000 feet, board measure had to be obtained almost immediately, those acquainted with lumber conditions can realize what this meant.

The endeavour of the board and the rule set by the chairman, was that everything possible was to be bought in Canada if it were obtainable at reasonable prices, and this policy was adhered to throughout so that all the money about $70,000,000 expended by

the British Government for boats remained as far as possible within Canada.

The first steel boat delivered was the War Dog, August 6th, 1917, from Wallace Shipyards, Ltd., Vancouver, followed by the War Wasp on August 30th of that year from the Nova Scotia Steel & Coal Co., New Glasgow; then the War Fish from Port Arthur Shipbuilding Co., November 20th, 1917; while the first wooden ship the War Sioux, was delivered in September, 1918, by the Great Lakes Dredging Co., Ltd., Fort William. As to concrete boats this class of vessel did not appeal to the director, who felt that while for certain purposes they might be useful, for sea-going purposes they were still in the experimental stage.

Government Plans.

In January, 1918 the Canadian Government expressed their intention of taking up shipbuilding as a national undertaking. Though the Imperial Munitions Board was just on the verge of making further contracts in Canada for additional steel boats, and was also considering the construction of further wooden standardized boats of 3,000 and 1,000 tons deadweight, the latter being for special service on the English and French coasts, these negotiations were at once cancelled and the work of shipbuilding continued by the Canadian Government.

Shortly after the signing of the armistice in 1918, it was felt that better oversight could be given to the remaining boats by moving the offices to Montreal and the shipbuilding department with the remaining staff, was transferred to the Drummond Building, where it has remained up to the present, and is now being closed.

In addition to the wooden vessels already enumerated, the following contracts for steel vessels were made by the Imperial Munitions Board under Col. Gear as director; Canadian Vickers Ltd. Montreal, 4 of 7,000 tons; J. Coughlan & Sons, Vancouver, 9 of 8,800; Wallace Shipyards, North Vancouver, 1 of 4,500, 2 of 4,600; Port Arthur Shipbuilding Co., Ltd., 1 of 4,300, 6 of 3,400; Collingwood Shipbuilding Co., 2 of 2,900; Midland Shipbuilding Co., Ltd., 3 of 3,400; British American Shipbuilding Co., Welland, 3 of 3,500; Canadian General Electric Co., Bridgeburg, 2 of 3,500; Polson Iron-works, Ltd., 6 of 3.500; Nova Scotia Steel & Coal Co., Ltd., New Glasgow, 1 of 1,800, 1 of 2,400; car ferry Leonard purchased, 1 of 2,263 tons; total steel deadweight tonnage, 206,563. Wooden shipbuilding operations on the Pacific coast included the Foundation Company, Victoria, B. C., 5 of 3,100; Cameron Genoa Company, Victoria, 4 of 3,100; New Westminster Construction Company, 4 of 3,100; Western Canada Construction Co., 6 of 3,100; Pacific Construction Co., Coquitlam, 2 of 3,100; Wm. Lyall Shipbuilding Co., North Vancouver, 6 of 3,100; total 83,700 tons, added to which was 58,900 tons of wooden shipping built by Eastern plants, already referred to; the total deadweight tonnage for 88 steel and wooden ships being 349.163.

Some criticism has been made of the wooden vessels; but it is stated these were all substantially built in every particular and were given in Lloyd's Register, under whose supervision they were built, twelve years' class. They are all in service and are said to be giving satisfaction to their present owner.

In the building great secrecy had to be maintained and this survey of the operations of the Imperial Munition Board in Canadian shipyards is the first that has been made public.

LAUNCHING OF SS. "ST. MIHIEL," 26th SEPT., 1918.
(W... carrying capacity 4,300 gross tons. Built for
Trans Atlantic Service by Dominion Ship-
building Co., Toronto.

The St. Lawrence Welding Company of Montreal

The St. Lawrence Welding Company of Montreal is not a large concern, as things go these days, but it has been much smaller, and judging from the specialised character of its work and the niche it fills in the metal-working industries of Quebec, it bids fair to become much larger. Recently, the Company added to its equipment a boiler shop, with 6,000 ft. of floor space, equipped to handle any variety of steel-plate work up to a thickness of three-quarter inch. The specialties of the concern include steel rivetted, or welded, tanks, smoke-stacks, boiler breechings, mixing tanks, soda tanks, steel digesters and specialties for the pulp and paper industry.

The St. Lawrence Company has had much experience in the repairs required aboard ships, and, as will be observed from the accompanying cut, a port-

WATER-WHEEL RUNNER, BUILT UP BY ELECTRICAL WELDING PROCESS

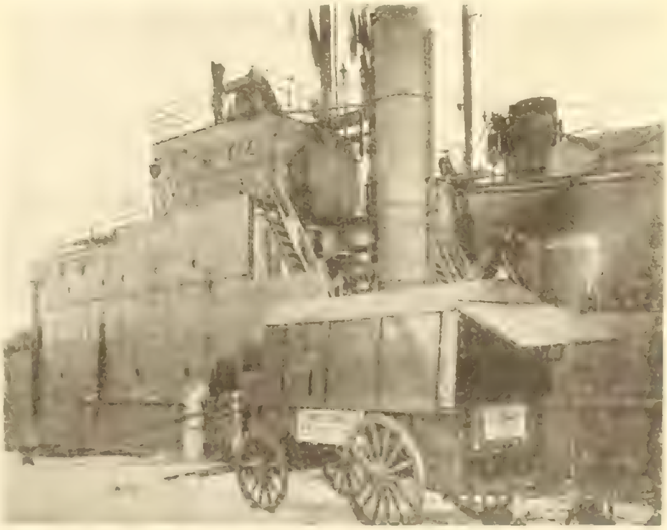
able equipment has been designed to meet the special requirements of ship repairs as to time and quick accessibility. The slogan of the concern is "We can weld anything, anywhere." This aim was realised during the war, when practically the entire capacity of the Company's equipment was taken by the British Admiralty. Very often it happened that the Admiralty could not afford to lay vessels up in port for minor repairs, and so parties of men went aboard and did their work on the high seas. One party from the St. Lawrence Company worked aboard an Admiralty vessel all the voyage out to Malta, and were not returned to the home plant for six months. Still another party went to Hong Kong, and the General Manager, Mr. N. Barry, was rated as a naval lieutenant, and made the voyage to France on Admiralty vessels several times.

Welding work, as the name of the Company indicates, is a principal part of its operations, and a lead-buring department is also included.

As an instance of the specialised and up-to-date character of the work undertaken by this Company, is the application of electric welding to the building-up of the waterwheel runner shown in the accompanying illustration.

In the initial construction of these waterwheels, difficulty has frequently been experienced in obtaining a firm and rigid connection where the vanes join the supporting rings. Generally speaking, the vanes are steel castings that are placed in position in the sand mold so that the molten iron will flow about the edges and form an integral casting. However, the result has often been unsatisfactory, as the subsequent expansion and construction of the vanes and the rings causes a looseness in one or more of the connections. The peculiar construction of the vanes makes it difficult to use the oxy-acetylene process in uniting the vanes to the retaining rings, and relatively poor success has, so far, been obtained by the use of the electric process, when working together steel and cast iron. However, the St. Lawrence Welding Co. has perfected a special flux that overcomes former difficulties, and the vanes can be so rigidly secured to the cast-iron rings, by means of the electric arc method that the force of a sledge upon any of the vanes will not produce the slightest defect in the welded joints. The cut shows the work immediately after welding. The rough appearance of the added metal was subsequently removed by grinding, leaving a smooth fillet weld in from the outer edges. Water-wheels have shown greater efficiency after welding by this method.

The General Manager is Mr. A. N. Barry. The tank shop is in charge of Mr. Thos. Galley, who has had 18 years experience in the construction of steel tanks in the United States. Mr. T. Rogers, formerly Purchasing Agent for Darling Bros., is Sales Agent



PORTABLE WELDING AND REPAIRING OUTFIT FOR SHIP REPAIR WORK

The Shipbuilding Industry in Nova Scotia

By PERCY McMILLAN.*

The ship-building industry in various forms is perhaps as old and as well known in Nova Scotia as in any maritime province in Canada. For over one hundred years wooden ships of all sizes and types have been built in Nova Scotia, and not only built, but owned, operated, and sailed by Nova Scotians. There are many comfortable homes and fortunes in this Province today as a result of ship-building and ship-owning fifty or seventy-five years ago.

Nova Scotian ships in those days were known in every port in the world, and even now in many of these ports a Nova Scotian is looked upon as a sailor always, while a Canadian is more of a farmer. The Province of Nova Scotia had the distinction at one time of owning more tons of shipping per capita than any other country in the world. But with the advent of the steam cargo tramp-steamer, wooden ship-building in Nova Scotia and elsewhere began to decline, until the square-rigged type disappeared altogether over twenty years ago. Ship-building, however, in various parts of the Province, still survived and flourished. The large fishing fleets on the South Shore were built for the most part during the last twenty years, and are owned in their home ports, and operated on a profit-sharing plan which has proven a success to all concerned. The design of these fishing vessels has changed considerably in these last few years. Formerly they were larger carriers on a smaller draft. Today these vessels look more like sailing yachts, and have a draft of some seventeen feet, which makes them capable, together with some permanent ballast, of carrying a large rail-area, which they invariably do. A fishing vessel must be well-built and well found to withstand all weather on the Nova Scotia and Newfoundland coasts where they operate, and their useful life in this business is not as long as the ordinary cargo carrier. The older type of fishing vessel, after a few years' service, was often sold as a coaster, but the present type is not suitable for that purpose. There is, therefore, a scarcity of the smaller type of coasters, as there are very few being built especially for this trade. There are, however, a good number of tern or three-masted schooners being built. These are principally employed in the West Indies and South American trade, also from Gulf to American ports, and it is not uncommon for them to cross the ocean with cargoes of lumber and fish. While these are handy vessels for many trades the growing scarcity of suitable timber increases the cost and restricts the output. Owners are therefore, turning for relief to steel vessels with small auxiliary power, usually oil or gasoline. The most up-to-date fishing vessel also may soon find itself superseded by the modern trawler. Steel here has even a greater advantage over wood than in the sailing vessel. These boats should have high power, as they do their work in all kinds of weather and must be seaworthy in every respect. This condition is more easily secured and maintained in a steel than a wooden hull.

THE SHIPYARD OF THE NOVA SCOTIA STEEL & COAL CO., NEW GLASGOW, SHOWING "CANADIAN SEALER" APPROACHING COMPLETION AND SECOND VESSEL ON THE STOCKS

While wooden ship-building in Nova Scotia is an old

* Superintendent of Shipbuilding Nova Scotia Steel & Coal Co., New Glasgow, N.S

industry, the building of steel ships is only in its infancy. It is only a little over three years ago that the first keel was laid in New Glasgow of a two-thousand ton steamer by the Nova Scotia Steel & Coal Co. The yard, while not large, has delivered four cargo steamers, with two more nearing completion, one twenty-eight hundred ton cargo steamer on order, together with one hundred and fifty foot steel yacht. The Nova Scotia Steel & Coal Co. is in an exceptionally good position for ship-building. All frames and angles, and a large percentage of the plates are rolled at the Company's plant near the yard. All rivets, bolts, light and heavy engine-forgings are made at the company's plant. The boilers for the steamers are now being built at the ship-yard, and the engines built complete in the company's engine shops, when the regular work will permit. The ship yard is situated on the East River of Pictou near the Eastern Car Company's plant, a subsidiary of the Nova Scotia Steel & Coal Co .

Steel ship-building, however, is not by any means a new industry in New Glasgow. In 1893 the firm of I. Matheson & Co., built the steel steamer "Mulgrave" and after twenty-three years good service this vessel was sold to be used as a coasting steamer and a ferry boat across the Strait of Canso.

In the year 1908 the "James William," a three-masted steel schooner of eight houndred tons dead weight was built by the same firm for the J. W. Carmichael & Co., of New Glasgow. She is still afloat and giving excellent service.

The Halifax Shipyards Ltd., Halifax, the only steel shipyard in Nova Scotia besides the Nova Scotia Steel & Coal Co.'s, bought the Halifax dry-dock and what remained of the repair plant after the Halifax explosion. This is now one of the biggest yards in Canada, having two eight thousand and two ten thousand ton ships under construction, besides doing practically all the repair work, large and small entering the port of Halifax. This means a tremendous amount of work, especially during such a stormy season as is the present one.

On the whole the future of steel ship-building in the province of Nova Scotia appears bright, especially in view of the fact that the new five-million dollar plate mill at Sydney will soon begin to roll ship plates up to any size required. The mill itself has a monthly output of about ten thousand tons, which will meet all demands in Canada, at least for some years to come.

If the province of Nova Scotia cannot continue to build ships and operate them at a profit, with all the past traditions, its intelligent workmen and natural advantages in the way of location and raw material, it is difficult to see how Canada can ever hope to become a ship-building nation.

The Nova Scotia Steel & Coal Co., Limited

Record of the War Period, Present Status of the Company and Prospects. Reviewed by the President.

Shortly after the outbreak of the hostilities in Europe, when the demand for shells became so great that the British Ordnance Works were taxed to their utmost and it became evident that they would be unable to continue to cope with the calls for over increasing quantities of these articles of destruction, the War Office appealed to Canada for assistance, and from that time onward to the signing of the Armistice on November 11th, 1918, the activities of the Nova Scotia Steel and Coal Company, Limited, were devoted insofar as possible to the maximum production of munitions and other materials required by Britain and her Allies. The steel manufactured by the Company having been found, on testing at the Quebec Arsenal, to be satisfactory for shell making purposes, the hydraulic presses at the New Glasgow plant were immediately fitted with dies, stripping apparatus and other equipment necessary to produce shell forgings of various sizes and additional miscellaneous machinery was purchased and installed. From October 21st 1914, the date on which the first lot of shell forgings was forwarded from New Glasgow, until Nocember 11th, 1918 the Company manufactured and shipped

	Shell Forgings
342,442	15 Pr.
10,319,015	18 Pr.
2,078,749	4.5″
16,304	60 Pr.
132,634	8″
30,363	9.2″
	Discs
50,252	15 Pr.
6,811,244	18 Pr.
	Base Plates
796,459	18 Pr.
2,731,363	4.5″
110,000	60 Pr.

representing 166,379 tons of steel. A reference to the following tabulation showing the output of coal, pig iron and steel ingots of the Nova Scotia Steel and Coal Company during the War period and one year since. will give the reader an idea of the proportion of the Company's steel production that went into the manufacture of shells and accessories apart from the large tonnages used in the manufacture of structural shapes and plates for the erection of railway cars, mine cars, and steel steamships. also for marine forgings, railroad track supplies, etc.

Year.	Coal tons.	Pig iron tons.	Steel ingots tons.
1914	752,153	24,678	53,334
1915	611,923	73,110	97,072
1916	591,869	81,507	129,903
1917	577,212	86,153	127,808
1918	502,051	92,174	129,506
1919	550,965	35,676	58,238

In addition to the manufacture of shell forgings and accessories, the Scotia Company assembled and finished complete for loading with explosives.

	Shrapnel Shells.
293,784	18 Pr.
	High Explosive Shells
100,493	4.5″
10,000	60 Pr.
2,127	8″
13,688	9.2″

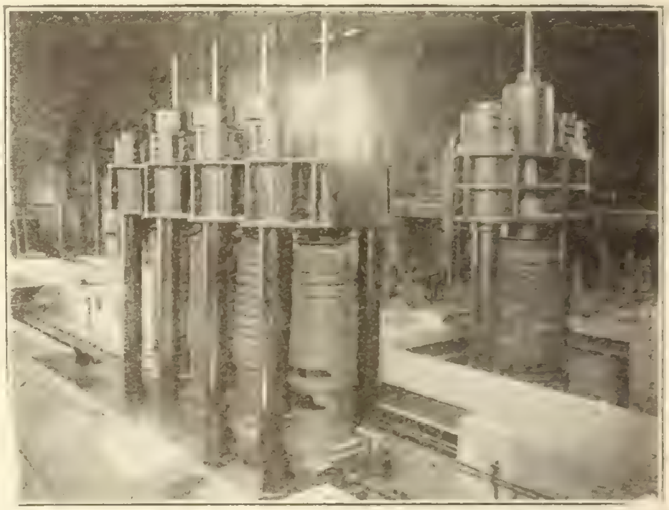
During the year 1914 to 1918, inclusive, a total of almost $2,000,000 was expended for plant and equipment necessary for the forging and finishing of shells.

MAKING THE PLATES AND RAIL-FASTENINGS AT NEW GLASGOW, N.S.

In the latter part of 1915 and early in 1916, it became apparent that there was a pressing necessity for more ships to effect the heavy losses being suffered through the submarine warfare and in May 1916 the Nova Scotia Steel and Coal Company undertook the erection of a shipyard. The keel of the first vessel was laid in August 1916 and from that date to the end of 1918 steel vessels were compelted and put into service as follows: the S.S. War Wasp of 2200 tons deadweight cargo capacity, 220 feet long by 35 feet beam and 20 feet moulded depth, launched on July 9, 1917, and delivered to the order of the Imperial Munitions Board; the S.S. War Bee of 2400 tons deadweight cargo capacity, 248 feet 9 inches long by 35 feet beam and 20 feet moulded depth, launched May 20th, 1918, also delivered to the Imperial Munitions Board, and the S.S. Watuka of the same deadweight cargo capacity and dimensions as the "War Bee," launched December 5th, 1918, and placed in our own service. A fourth vessel, the "Canadian Sealer," was built under contract for the Canadian Government Merchant Marine and launched on October 8th, 1919. This steamer has a deadweight cargo capacity of 2[illegible]00 tons, 270 feet between perpendiculars, 38 feet beam and 26 feet 6 inches moulded depth. We also have two other vessels of the same dimensions on the ways at present and upon completion they will be followed by others.

In addition to the operations of the Steel Company proper, we might mention that during the War the Eastern Car Company, a subsidiary, manufactured 13853 railway cars, 4100 of which were for the French Government, 4400 for the Russian Government, 2936 for the Canadian Government, and a number for the Reid Newfoundland Company and Grand Trunk Railway, as well as pit cars for the Scotia Company's mining operations and the Acadia Coal Company.

Immediately after the signing of the Armistice all munitions work ceased and although the steel plants of the Scotia Company were operated fairly steadily during the first quarter of 1919, the demand for ordinary commercial steel products was very limited owing to the hesitancy on the part of prospective purchasers to place orders on account of the world wide uncertain conditions and it was decided to shut-down for a few months in order to make necessary repairs in all departments so badly needed



THE INGOT COMPRESSION PLANT AT SYDNEY MINES

after the pressure of over four years of war work.

Since last Fall there has been a very much improved demand for steel products both by Canadian consumers and for export and at present the steel plants of the Scotia Company are being operated to capacity, with prospects of continuance, in fulfillment of substantial orders now on our books.

The future of the steel industry is promising and the satisfactory financial status of the Scotia Company and its possession of enormous natural resources place it in a position to go ahead with proposals now in hand for improved and more extensive operations.

Trade papers have already announced some of the investments made by the Company during the past year, among which may be mentioned the purchase of a modern coal handling and bunkering plant at Halifax, the controlling interest in the Acadia Coal Company and large timber limits in Pictou County. These investments will have an important bearing on the future operations of the Nova Scotia Steel and Coal Company in conjunction with plans now under consideration.

Mechanical Loading Devices For Mines

The present, and prospective, shortage of men who are willing to undertake hard manual labour underground, has led mine managers to turn their attention to the perfecting of mechanical devices for underground use in substitution for manual labourers. A further compelling reason for studying the possibilities of these devices is the shortened working day, which requires intensive production if anything like full interest is to be earned on the plants that have been designed to handle greater quantities than it is possible to produce in a shortened working day.

The limiting conditions attendant upon the design and operation of mechanical devices for use underground are much more irksome than in the case of overground operation, because, in addition to the limitations of size imposed by the restricted area of mine passages, and a further restriction of weight required in order to achieve portability underground, there are considerations of ventilation and the presence of mine gases that limit the motive powers that may be used.

The conditions attending iron-ore mining and, in some favoured instances, copper and precious-metal mining, are less limiting than those associated with coal mining, and therefore the evolution of mechanical loading machines has proceeded most rapidly in metal mining.

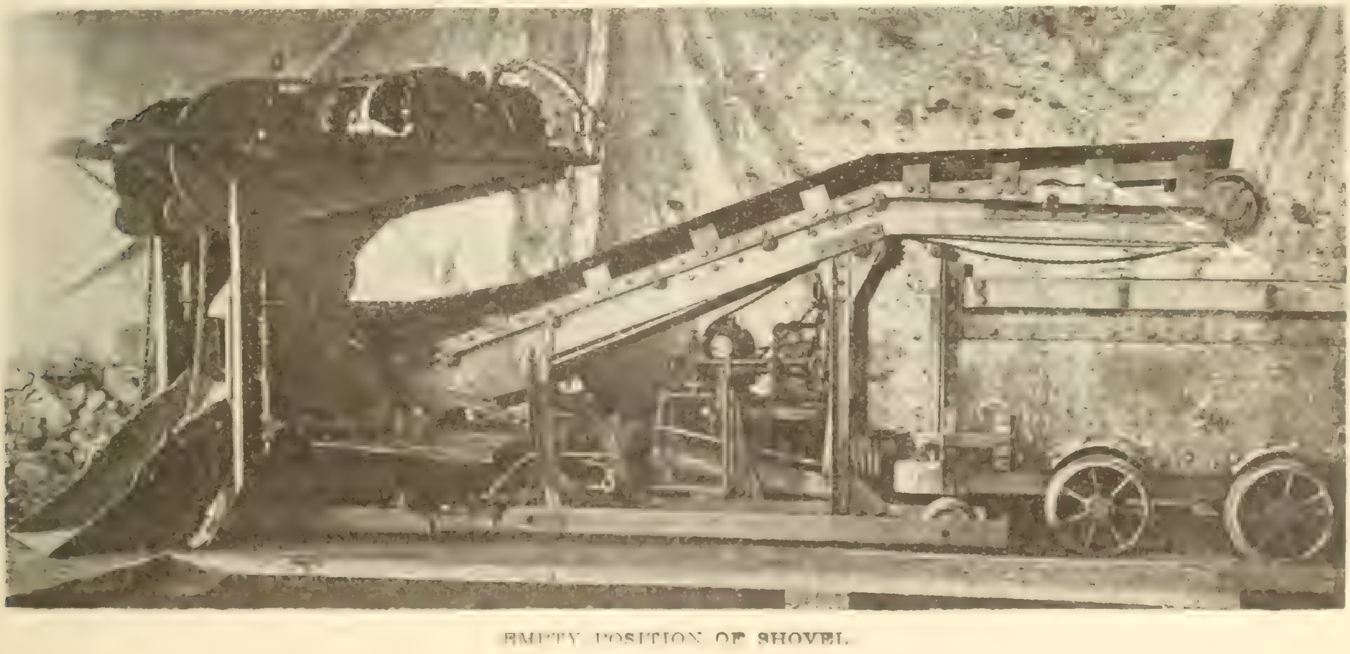
The accompanying photographs show a mucking machine that was recently put into operation in a Michigan copper mine, and is giving satisfactory service. It loads from 15 to 30 tons of ore an hour, depending on the depth of the bank. It is operated by compressed air, and has a reach of eight feet on either side of the centre line of the track. The photographs show the machine in three working positions, viz., empty, loading and loaded. We should be pleased to put any of our readers into touch with the designer of the device. It was designed and built at the mine where it is in use, and is shown in the photographs as it appeared when ready to leave the shop.

Loading shovels have been successfully operated for some time past in the mines of the Nova Scotia Steel Company and of the Dominion Steel Company at Wabana, Newfoundland. In these instances the great height of the seam,the width of the passages, and the tremendous blasts that are made provide an unusually favourable condition, as underground conditions go, for the use of a mechanical loader.

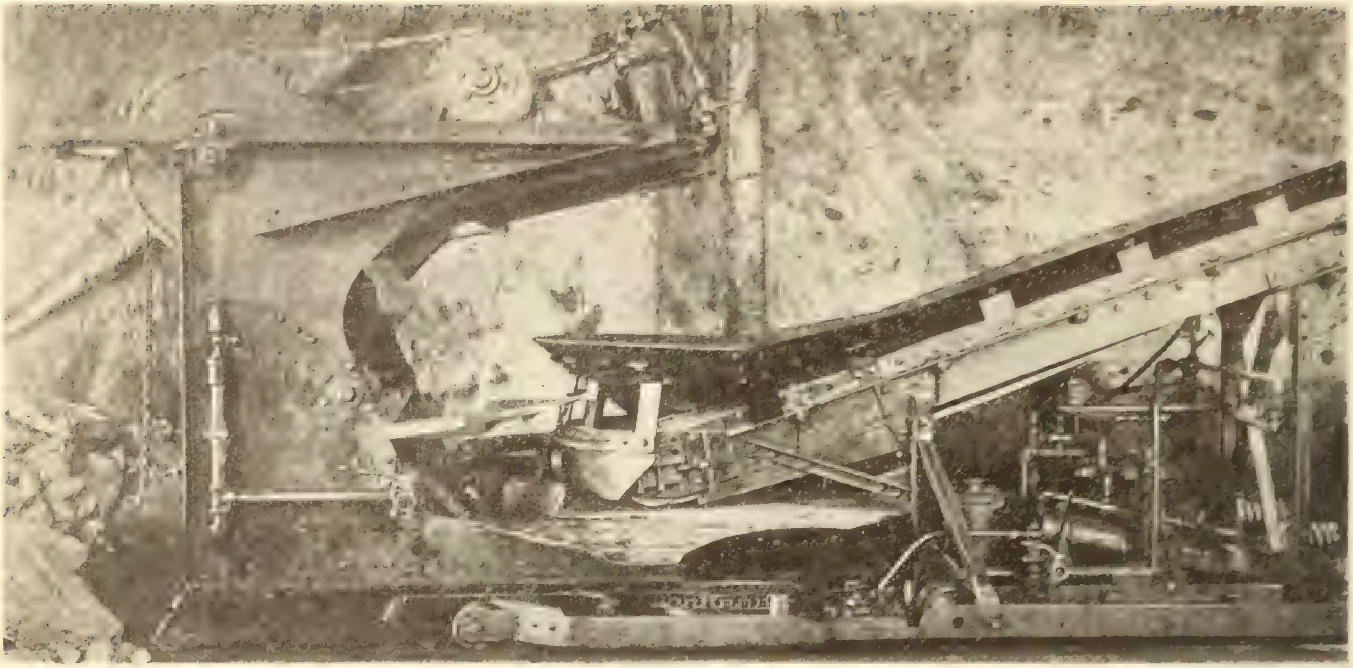
The Dominion Coal Company has also tried a shovel of a smaller type in its coal-mines at Glace Bay, and will in course of time evolve a satisfactory device, but the conditions of operations are very onerous, and probably a greater deterrent than anything else is the attitude of the workmen towards the introduction of these labour-saving machines. The further extended use of these devices will, however, be compelled by the growing and probably permanent shortage of unskilled labour in this district, and by the necessity to cut the costs of coal production by the adoption of every possible means.

It is also understood that the Hollinger Mines are experimenting with a mechanical loader, having been impelled to this by a similar shortage of suitable labour. At the Sullivan Mine, in British Columbia, similar experiments are being conducted.

It is reported from the Lake Superior region that much progress is being made in adapting mechanical loaders to underground conditions. According to the Ishpeming "Iron Ore," the M. A. Hanna Company has placed on order for ten Middlemiss loaders. These machines will be constructed in Milwaukee, and if as good results are obtained as experiments indicate, further orders are likely. The Cleveland-Cliffs Iron Company has a Lake Superior loader at its Barnes-Hecker property, and a Hoar machine at the Holmes mine, both of which are claimed to be doing good work. The Halby loader is stated to be in general use in the Lake Superior district.



EMPTY POSITION OF SHOVEL



LOADING POSITION OF SHOVEL

"Iron Ore" agrees with the belief of this periodical that common labour will be in insufficient supply for a long time to come.

The exodus of labourers to Europe is a fact now in process of accomplishment, but the full tide of the outward movement has not been reached. There is also a decided tendency for men to move to the larger centres of population. Employers of labour must realize that not only is the day of moderately-priced manual work departed, but that added to the prevailing disinclination of men to undertake laborious manual employment, there is a definite and actual shortage of suitable workmen for this type of work in all the mining centres.

Investigation of the applicability of mechanical devices in substitution for manual effort, and actual experimentation with such devices under operating conditions, is a duty incumbent upon all operating heads who desire to maintain production; and those chief executives who wish to show a fair profit in the balance sheet will be well advised to provide the necessary appropriations for mechanical equipment and to forward the evolution of perfected loading machines by every means.

SHOVEL LOADED

An Underground Loading Pocket Adapted for Heavy Ores

JOHN S. WATTS, New Glasgow, N.S.

The drawings accompanying this article, show a highly successful underground loading pocket installed last year, in the submarine iron mine of the Nova Scotia Steel & Coal Co. at Wabana, Newfoundland.

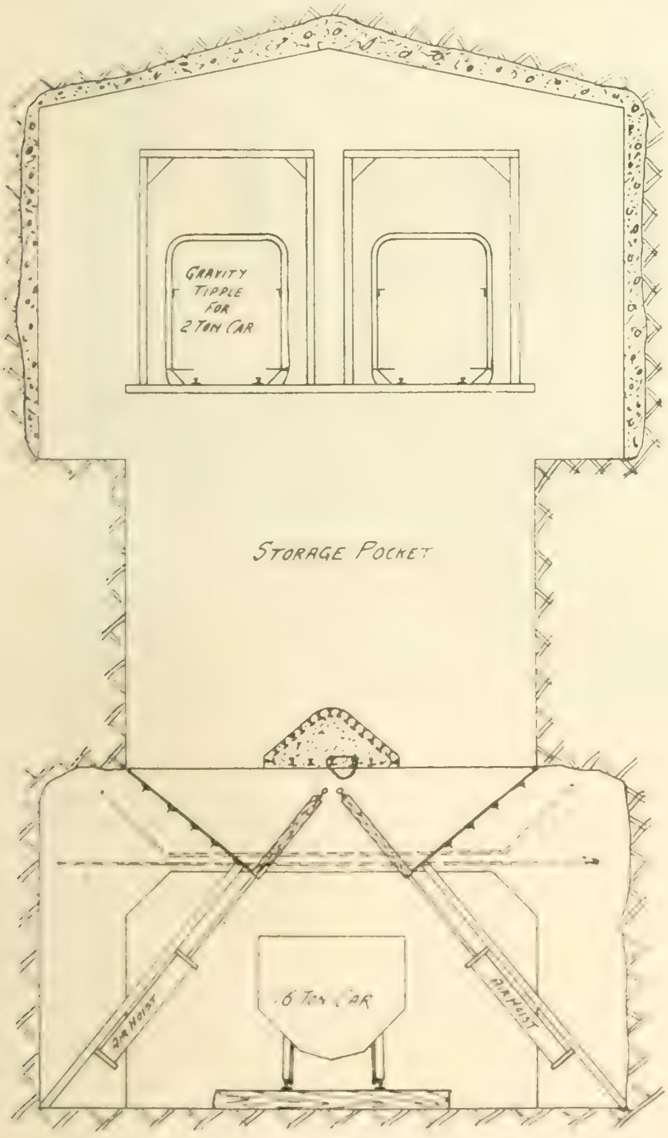
The product of this mine is a hard iron ore, and is mined in large lumps, frequently in cubes measuring three feet each way, and weighing over two tons each.

These heavy pieces make it a difficult proposition to control the loading by any of the ordinary varieties of gates. The design shown in the drawings is the result of much thought, and has proved successful, beyond all expectation.

The original intention was to break the larger pieces of ore, in the mine allowing no piece with any dimension of over two feet to get into the pocket.

This limit has, since, been raised to three feet, as it was found, by experience, that that size gave no trouble, and, as a matter of fact, larger pieces even than three feet have been passed through the gate without sticking.

The method of operation, is, to bring the ore from the working faces, in small cars, to the tipple shown in the drawing, above the pocket. The tipples empty the cars by upsetting them, and return the car to its upright position by gravity.



The centres of gravity of the car andripple, are so arranged, relatively to the centre of suspension of the tipple, that the full car causes the tipple to turn over, and when the car is empty, the tipple returns by gravity to its original position, which is as it is shown in the drawing.

The empty car is then pushed off, and replaced by a loaded car, and the operation is repeated. The movements of the tipple are controlled by a hand brake, not shown on these drawings.

As may be seen from the drawing, the bottom of the pocket is of concrete, strongly reinforced, with worn rails,to stand the shock of the dumping of the ore. Also it will be observed that at all places, where the movement of the ore would cause abrasion of the concrete, the surfaces have been lined with rails.

In the bottom of the pocket, places have been provided for six chutes and control gates, but only three chutes have been fitted and have proved sufficient.

These chutes empty the ore from the pocket into a sixteen-ton capacity car, which car carries the ore up to the deckhead on the surface.

It has been found that one of these cars can be loaded to capacity with sixteen tons of ore in less than thirty seconds, and it probably would be done in less time, were it not for the fact that the cars cannot be unloaded as quickly, and the two operations are performeed simultaneously, the hoisting being done in balance.

The main improvement in this pocket, over the old one, is, that the control gate rises through the stream of ore to shut it off; instead of pushing down into the ore, as is the more common method.

It is obvious that there is nothing to prevent this door closing, except the weight of the ore on top of the door, and the friction of the ore against the gate. This merely involves applying sufficient power to overcome the resistance, and then perfect control is attained.

With the downward closing door, however, a lump of ore will get stuck under the door, and make it impossible to get it closed until this lump is got out of the way, by which time the car will be overloaded, and ore piled up on the floor around the car, to be later shovelled out of the way.

It is somewhat of a mystery to me why this type of door is not more generally used, as while it needs more careful designing and manufacture, to avoid the danger of its getting jammed by fines or dirt accumulating in the guides; its perfect control and reliability under the roughest of treatment well repays the small extra cost.

In fairness to all, the writer should state that he thought when designing this gate, that he had invented something new, but discovered afterwards, that the idea of making the gate come up through the stream of ore had been used by others, previously. Particulars of two doors on this principle, are published in "The Handbook of Mining Machinery," published by "Mines and Minerals." Neither of these doors, however, are subject to the severe treatment, that the one described has to withstand.

The Canadian Furnace Company of Port Colborne, Ont.

Commencing operations on Sept. 27th. 1913 when the furnace was successfully blown in, the Canadian Furnace Company of Port Colborne, has steadily continued its annual output of 120,000 tons of foundry and malleable iron. Situated at the junction of the Welland Canal and Lake Erie, the plant has a frontage of 2,200 feet on the canal, most of which is docked. All told, the property covers fifty acres, part of which is still under water, the land having been leased from the Government for a term of 63 years. At the dock there is a depth of 25 feet of water but the layout provides for a depth of thirty feet, and with these excellent facilities the largest lake boats are able to discharge their cargoes of raw material at the dock. The cargoes consist of ore from Lake Superior points. Limestone is shipped from Calcite, Mich., and coke from the Connellsville region in Pennsylvania and by-product coke plants in Canada. The location of the furnace is exceptionally good, being on the highway between the Great Lakes and eastern points, affording the best facilities for the distribution of the products and assemblage of the raw materials. This feature from an economic standpoint is very important as it has enabled the handling of materials to be reduced to a minimum, with a consequent reduction in operating expenses.

The industrial-track system is standard-guage and it is connected with the Grand Trunk Railway, while the Company's own locomotives operate the system. Under normal conditions about 150 men are employed in the operation of the present furnace which has a capacity of 325 tons per day. Provision has been made, however, for the building of another furnace on the lake side of the present furnace.

The ore dock has a frontage of 600 feet on the canal and has a width for storage purposes, of 235 feet. This furnishes storage accommodation for about 250,000 tons of ore and 100,000 tons of limestone for use during the period when navigation is closed. Tracks are laid the full length of the ore-dock or storage yard, and on each side for the ore bridge's which carry the raw materials from the ships at the dock to the storage-bin system or to the yard, according to requirements.

There are two substantial steel ore-discharging bridges supplied by the McMyler Interstate Co., Cleveland. They have a main span the full width of the storage yard, viz. 350 feet, and in adition have at the canal end, a swinging apron 50 feet long, and at the shore end over the bin-system tracks, a cantilever span of 40 feet. The bridges are 50 feet high from the dock-level to its underside, They are electrically operated and equipped with 5 ton buckets.

When in operation, the ore or stone, is carried from the ship at the dock along the ore-bridge into the transfer-car which runs on tracks laid over the storage bin system, the car being stationed under the cantilever arm to receive the contents of the bucket. The transfer car has a capacity of 30 tons, is electrically operated and was supplied by the Brown Hoisting Machinery Company. When full the car travels along and deposits the ore into the bins underneath according to the grade of the ore being handled. The inclined-trestle approach from the railway tracks to the top of the bin-system is 850 feet long and 30 feet high at the bine.

The coke is received in cars over the trestle and is dumped directly from each car into the coke bins adjacent to the skip-bridge. The coke is drawn directly from the bins to the skip-cars.

THE CANADIAN FURNACE COMPANY'S PLANT, PORT COLBORNE, ONT.

Storage Bin System.

There are six ore bins in the storage bin-system, with a total capacity of 1800 tons, together with two limestone bins with a total capacity of 500 tons, and two bins capable of storing 600 tons of coke. These bins have been bricked in and a heating system prevents freezing in severe weather. The stock-house is underneath the bin system and it is equipped with tracks for operating the scale car. The latter has a capacity of 10 tons and is electrically operated. An interesting feature of the car, which transfers the materials from the bins to the skips, is that it is equipped with a series of scales which are set to regsiter the amount taken from each bin, and in the desired proportions according to the grade of pig iron required.

The Skip Hoist.

The steel skip-bridge is double track, there being two skip cars, one ascending and the other descending, operated by a steam hoist. The charge for the furnace consists of 2 skips of ore, one of stone and two of coke, which is equivalent to 13,600 lbs of ore, 3400 lbs. of stone and 6500 lbs. of coke, the proportion varying according to the product required.

The Furnace.

The furnace is located at the lake end of the cast house and is 80 feet high, 13' 6" in diameter at the hearth, 19' 6" in diameter at the bosh, and 11' 6" at the stock line. There are ten tuyeres, through which air is blown at 15 lbs pressure. The McKee top-charging apparatus consists of a receiving hopper, which is conical in form and rests on bail bearings supported on top of the gas-seal, and through suitable gearing is rotated by a motor on the furnace structure, insuring even distribution of the stock charged.

The Cast House.

The cast-house is 200 feet long from the centre line of the furnace and 65 feet wide and is built of steel. The top part only of the sides is covered in, allowing sufficient space for loading cars from the pig bed, tracks running along outside for the purpose. Overhead runways extend the full length and over both sides of the pig-bed and are equipped with McMyler chain-blocks for handling the pattern used for making the pig moulds. Outside the cast house is a pit 20 feet in diameter by 20 feet deep for granulating the slag.

Both the boiler-house and the power-house contain modern equipment. For heating the blast there are four stoves of the two-pass vertical type, made of steel plate and lined with fire brick. The company generates its own power by two Curtis impulse-type steam-turbines. The blast for the furnace is furnished by two high-pressure and one low-pressure Allis-Chalmers vertical long crosshead blowing engines, with air cylinders 84" in diameter x 60 inches stroke.

SALESMEN OF CANADA METAL COMPANY IN CONVENTION

THE CANADA METAL COMPANY, OF TORONTO, HOLDS ITS ANNUAL SALES CONVENTION.

In opening the Annual Sales Convention of the Canada Metal Company, on January 19th at which forty-five salesmen were in attendance, the President of the Company, Mr Harris, said that 1919, despite its strenuous character had been the best year in the Company's history, and that 1920 promised to be even more prosperous.

The salesmen were shown the process of making babbitt metals, and practical demonstration was made by the metallurgist of the tests used by the Company to ensure the purity of its alloys. Tests of hardness by the Brinnel device, and the use of the pyrometer in governing temperatures were explained, and the manufacture of lead pipe, and lead and brass plumbing supplies were shown.

In the evening the staff of the Company was entertained at dinner by the President, and, as a mark of the Company's appreciation of loyal service, each member of the staff was presented with a life insurance policy.

On the following day a visit was made to the works of John Inglis Co., where opportunity was given for

inspection of the marine engines made by this Company, and the salesmen were able to see the various uses of babbitt metal in the engine parts.

Later, and following presentations to salesmen with the best record for 1919, a visit was made to the Company's nail factory, where some fifty tons of nails are being manufactured every day, without being able to satisfy the order list. Nails from 3/8 inch to 8 inch are made in this plant and also staples, bale ties, and other wire-drawn products.

A policy that allows the salesmen of a Company to inspect and understand the manufacture of its products, and takes care to impress upon him the careful technique and supervision used in the preparation of the products he is required to sell, is commendable, because no salesman is so successful as the man who understands the manufacture of his product, and is personally assured of its excellence; and the reflex of this feeling among salesmen is provocative of a desire for still further excellence in the home shops.

Volta Electric Furnaces

Welland Manufacturing Company has kept well abreast of the great development in electric Steel Industry

The remarkable and steady growth of the electric steel industry during the past eight or nine years is one of the outstanding features of commercial activities in Canada and the United States. Statistics show at the end of 1919 electric furnaces to the number of 815 in operation or installed throughout the world for the production of steel ingots and castings, of which number 330 are in Canada and the United States. In 1910 there were only 114 electric steel furnaces in operation of which 13 were installed in Canada and the States.

In this development of the electric steel furnace industry the Volta Manufacturing Company Limited, of Welland, is playing a prominent part. The Volta electric furnace is now pretty generally known and widely used in the steel industry and has won a high place in steel circles both in this country and in the United States, by reason of its many exclusive features adopted after long experience and close study of requirements of the trade. The Volta electric furnace is of the Heroult type and is a clean cut, substantially built piece of machinery, perfectly balanced mechanically and electrically, ensuring a continuity of service which has given it a preference over many types. It is built in four sizes, namely 1-ton, 3-ton, 6-ton and 10-ton capacity and in each case, it is claimed, the furnace can be operated from 30 to 50 per cent above the capacity mentioned, while power consumption in the larger sizes runs at approximately 500 to 600 K. W. H. per ton of steel produced.

The furnace shell is made of heavy steel plate, substantially reinforced and properly rivetted together while the charging doors are designed in such a manner as to prevent warping and are easily manipulated at all times. Each furnace is provided with two removable roof rings, each of which is fitted with four lifting lugs. By providing the furnace with two roof rings it enables the operators to always have one spare roof made up on the floor so that when it is necessary to renew the roof of the furnace it can be done very quickly.

The tilting mechanism is an excellent feature of the

VOLTA ELECTRIC FURNACE
In position for pouring

Volta furnace. The furnace rests on a heavy rocker shaft placed towards the front of the furnace and two connecting rods connected to the tilting gear on the rear end of the furnace. An electric motor driving the tilting gear causes the connecting-rods to rise which lifts the rear of the furnace over a maximum height governed by the connecting-rod radius arms. This design eliminates any excessive strain either on the tilting gears or on the furnace shell and the lifting load on the tiling motor is reduced to a minimum. Should the operator allow the motor to continue running after the furnace has reached its highest maximum tilting point, the furnace would then commence to lower again and would continue to raise and lower to the maximum and minimum heights until such time as the motor stopped. The electric control, which can be placed at the most convenient point for the operator, permits of absolute control at any stage in the tilt, thus providing an absolutely safe and fool-proof tilting arrangement.

Other features of the Volta electric furnace are the roof-coolers, mast and jibs, electric-holder conductors and cable connections. Each electrode is controlled by means of an electric winch and the furnaces are controlled by a new type of regulator.

It is worthy of note that with the exception of the motors and the power transformers the company builds the furnace and all auxiliary equipment in its own plant at Welland. This results in increased efficiency as every part is designed for its own special purpose and the final assembling of the different component parts makes a furnace which is perfectly balanced in every respect.

SAM'L OSBORN (CANADA) LIMITED, OF MONTREAL.

As one of the latest indications of the tendency of British manufacturers to establish branch houses in Canada may be cited the newly formed concern of Sam'l Osborn (Canada) Limited, with headquarters at Montreal. This concern will distribute all the well-known products of Samuel Osborn & Co., of Sheffield, Eng., which include high-speed Mushet steels, carbon tool steels, mining steels, and manganese castings in variety. The Canadian Company has also absorbed the Canadian intertests of the Hardy Patent Pick Co., makers of mining tools, both hand and power types, and of Rylands Wire Rope Works, Eng.

The distributing equipment at Montreal comprises a large new building near the Grand Trunk Railway Station, which will be chiefly used for warehousing purposes, and machine shops. A furnace equipment for heat-treating of high-speed steels is provided, but, so far, there is not any intention to manufacture steel.

The President of the Company is Mr. A. E. Myles. The Vice-President is Mr. G. E. Leighton, who was for about fifteen years the Canadian representative of the Hardy Patent Pick Co., and is also well-known in Quebec as a consulting mining engineer. The Company has offices in Toronto, Winnipeg, Calgary and Vancouver, in addition to the Montreal headquarters.

C. M. I. TORONTO MEETING.

Provisional programme, Monday, March, 8th.

Morning Session.

Addresses of Welcome; Presidential address by D. H. McDougall; Mineral Statistics for 1919 by John McLeish, T. W. Gibson, T. C. Denis and W. Fleet Robertson (or by proxy); General business: Status of the engineer, etc.

Afternoon Session.

"Ferro-Alloys in Canada," by G. C. MacKenzie; "Electric Smelting of Tin Ore," by B. G. Cobb; Two papers on the Plate Mill of the Dominion Iron and Steel Co., and one on "Economies in Steel Plant Management," being arranged for by Mr. F. W. Gray, Secretary, Iron and Steel Section; "Iron Ranges of Michipicoten District, Ontario," by W. H. Collins.

Evening Session.

"The Mining and Smelting Operations of the International Nickel Company of Canada," written by The Company Staff. (Lantern slides); "Operations at Alfred Peat Bog" (illustrated by moving pictures), by A. A. Cole; "Some Aspects of the Mining Situation in the Middle West," by R. C. Wallace.

Tuesday, March 9th.

Morning Session.

Formation of Proposed Coal Section of the Institute; "Coal Mining in the Province of Alberta," by J. T. Stirling; "Fuel Problems of Western Canada," by W. J. Dick; "Coal Supply of Canada," by F. W. Gray; "Lignite in Saskatchewan," by A. McLean; "Briquetting Industry," by E. Stansfield.

Afternoon Session.

"Future Prospects for Oil and Gas Production in Ontario," by M. Y. Williams; "Natural Gas in Ontario," by E. S. Sstlin; "Oil Possibilities in Western Canada," by D. B. Dowling; "Oil Problems in Canada," by T. O. Bosworth; (Subject to Dr. Bosworth's being in Canada).

Evening Session.

Smoker and Concert in Pompeian Room; (Chairman, Mr. G. G. S. Lindsey and Colonel J. J. Penhale).

Wednesday, March 10th.

Morning Session:

Discussion on Institute's Prospecting Scheme, following an address by J. A. Campbell, M.P. on "Attitude of Canadian Governments toward Mining Development,"; "Britannia Mines, British Columbia," by S. J. Schfield; "Progress Notes on the Investigation of the Quebec Asbestos Deposits," by R. Harvie and E. Poitevin; "Asbestos Mining," by J. G. Ross.

Afternoon Session:

Discussion on nickel coinage; "Lost Placers of Ontario," by A. P. Coleman; "Recent Developments in Mining in Northern Ontario," by J. G. McMillan; "Geology of Silver Islet and Vicinity," by T. L. Tanton; "The Nipissing Mine," by H. Park; "Minerals of Eastern Ontario," by J. W. Evans.

Evening.

ANNUAL DINNER at 7.30 p.m. in the Pompeian Room.

Notes on the Labor Situation in Canada

Specially Contributed.

Previous to the war Canada got its common labor supply largely through immigration from Continental Europe.

During the period of the construction of the Grand Trunk Pacific and Canadian Northern railroads thousands of Italian, Austrian, Hungarian and Russian laborers came into the country.

When the war broke out in 1914 practically all the Italian and Russian laborers of military age either went back to Europe to join the army or joined the Canadian forces.

The subjects of the Central Powers were of course not allowed to leave Canada and during the winter of 1914-15 when industrial conditions were very bad and these men could not get work some thousands of them were gathered up by the Dominion Government Authorities and placed in internment camps in various parts of Canada.

During 1915 and 1916 when conditions had improved and when industrial plants and mines were working to capacity some hundreds of these laborers were released on parole from the internment camps for work in different parts of the country to make up to some extent for the shortage of common labor then existing. These men were all paid the regular wages that pertained to the industry in which they went to work.

At the conclusion of the war and as soon as travelling facilities could be obtained thousands of these laborers left Canada to return to their homes and at the present time other thousands are waiting to go as soon as passports and transportation are available, so that it looks at present as if there would be a serious shortage of common labor in the country when construction work starts up in about three months time—as it is very doubtful if the countries to which these laborers belong will sanction their leaving home for some time at least. It might be here mentioned that all or nearly all these men made big wages and took away with them hundreds of thousands of dollars in the aggregate.

Even if the men wanted to return to Canada and their governments were willing to give them permission to come the cost of travelling has advanced to such an extent that it is practically prohibitive. For instance a ticket from Europe to Canada that in pre-war days could be purchased for $30.00 now costs $75.00 and the recent enactment of the Dominion Department of Immigration whereby laborers and mechanics coming into Canada must be in possession of $250.00 adds to the difficulty particularly as the value of Continental money is now less than half of what it was in pre-war days.

One thing regarding new immigrants coming to Canada is practically certain and that is that men who have spent five years in the armies of Europe no matter how anxious they might be to get away from there cannot gather up sufficient money to travel under the above conditions.

The situation therefore that confronts the employer of common labor today is something as follows:—Some thousands of laborers have gone to their homes in Europe, other thousands are anxiously waiting to go and when railroad construction and other public works start up in April and May there is no available common labor.

There is no immigration into the country at present but some relaxation of the Government Regulations will no doubt be made.

It is well known that railroad construction and as a matter of fact all construction work pays higher wages to laborers than do the industrial plants—the reason for this being that construction is only temporary work whereas industrial plant work is looked upon as permanent nevertheless the question of permanency does not enter largely into the calculations of a man looking for a job. He goes where the wages are highest and consequently the construction job gets the pick of the men while the industrial operator takes what is left.

A perusal of the Trade Journals shows that the United States steel plants and coal mines at present are working to the limit of their labor supply and they are unable to take any more business, as their unfilled tonnage orders are growing larger each month, and it is reasonable to assume that this state of affairs will also apply to Canadian plants. It is hard to see how production can be increased if there is a shortage of labor to produce.

DOMINION STEEL COMPANY INCREASES WAGES of STEEL-WORKERS BY APPROXIMATELY TEN PER CENT.

The Dominion Steel Company, at the end of January, announced an increase in the wages of its steel employees averaging ten per cent, but graded so as to give a somewhat larger increase to the lower-paid workmen. The increase is retroactive to the first of the year. The official announcement was as follows:

The Dominion Iron and Steel Company announce that effective January 1st, 1920, a general increase in wages went into force averaging ten per cent.

Increases of thirteen to fourteen per cent were made to the lower paid workmen while the general average for the entire plant is somewhat over ten per cent.

THE TORONTO POTTERY COMPANY.

This Company is the Canadian subsidiary of the Robinson Clay Product Company, Akron, Ohio, who have twelve large brick plants in Ohio, Pennsylvania and Kentucky, and specialise in firebricks, fireclay and refractories for use in the metallurgical industries.

The Canadian offices are prepared to quote delivered prices in Canadian funds, and advise the ordering of firebrick well in advance of requirements, as the car-shortage now existing, and likely to grow in severity owing to the neglected equipment of the United States railways, will make deliveries difficult when the construction season opens. A heavy demand for all grades of clay products is expected during the construction period of 1920.

The Ore Deposits of Goudreau and Magpie-Hawk Areas, Michipicoten District, Ont.

The Summary Report of the Geological Survey, Part. E., 1918, contains a detailed report by W. H. Collins on the pyrite and iron ores of the Michipicoten District in which pyrite mining was greatly stimulated by increased domestic demand for sulphuric acid caused by war requirements and the cessation of shipments of Spanish pyrite. In 1918 the Survey entered this field with the intention of aiding prospecting and development.

An attempt was made to assign some definite stratigraphic horizon in the Keetwatin to the formation which carries the iron ore and pyrite. A tentative effort was made to recognize some of the members of the Keewatin group, arrange them in order of age, and even to represent them thus on the maps. The Report states:

> The attempt met with only a small degree of success. It was soon found in Goudreau area, explored first, that most of the iron-formation rests upon light coloured porphyries which, being volcanic flows, are, therefore, older. Also, that the flows above the iron-formation are largely, if not altogether, dark-coloured greenstones. On this basis the Keewatin in Goudreau area was separated into three parts; an older group of light-coloured acid volcanics, an intermediate one of iron-formation, and a younger one of dark-coloured, basic volcanics. Later on, however, it developed that this classification is only approximate; that there are a few acid volcanics apparently younger than the iron-formation and quite a few basic volcanics older than it. Nevertheless, the subdivision was successfully used in searching for and locating belts of iron-formation not heretofore known, so it has some practical value.
>
> An attempt to make a like threefold subdivision in Magpie-Hawk area failed. It is quite remarkable how many of the volcanics found in Goudreau area are also present in this area; but the distinction between acid and basic volcanics is not so pronounced. There are many of intermediate character, which could not be placed unhesitatingly in one division or the other, even on a lithological basis. It was also discovered, in the case of the Bartlett range, that the iron-formation does not lie between acid and basic flows but apparently within one acid tufaceous formation.

The main structural relationships of the rocks are shown in Fig. 1.

Pyrite and Iron Ores.

Pyrite, siderite and hematite are constituent part of the Keewatin iron-formation in Michipicoten District, and the pyrite deposits may be classed as range deposits for the most part. There are a few smaller bodies of high-grade pyrite presumably derived from the range deposits by solution, transportation and redeposition. There are still other small bodies in the Pleistocene drift, where the drift has been replaced by pyrite sand and granular silica, deposited from the mineralized waters that drain off the iron ranges. Thus there are three distinct types of pyrite deposits in this district.

An example of a replacement deposit in the drift is shown in Fig. 2, which refers to the Rand Consolidated Company's pit at Goudreau. This deposit

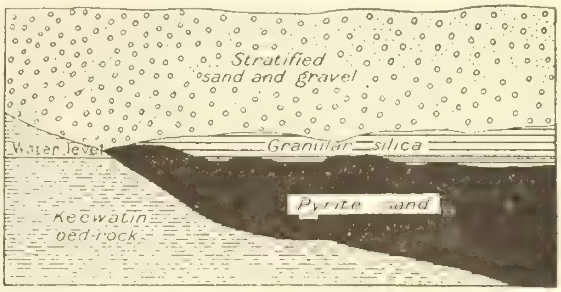


Figure 2. Diagram showing geological relationships of the body of pyrite sand in the Rand Consolidated Company's pit, Goudreau. This body is younger than the Pleistocene drift.

is modern in age, and the concentration is so perfect that the sand shows 95 per cent pyrite by analysis. The Report discusses at length the probable process by which this pyrite sand was laid down, and remarks that the similarity between the recent replacement deposits and the Keewatin iron ranges is sufficiently remarkable "to suggest that the banded silica and pyrite of the latter may have been concentrated by processes of solution and redeposition analogous to those which manifestly gave rise to the younger deposits."

The iron formation is composed essentially of banded silica, pyrite and siderite or sideritic limestone arranged in stratiform form. The banded silica is so perfectly stratified that the whole iron formation must be assumed to have been deposited horizontally in the first place and over considerable areas. Later earth movements have complicated the structure to an inexplicable extent.

> An effort has been made in Figures 3 and 4 to indicate the general stratigraphic character of the iron-formation by placing side by side cross sections of different parts of the ranges in both areas, those in Figure 3 representing surface exposures, whereas those in Figure 4 are from diamond-drill borings. The sections were selected so as to be as repre-

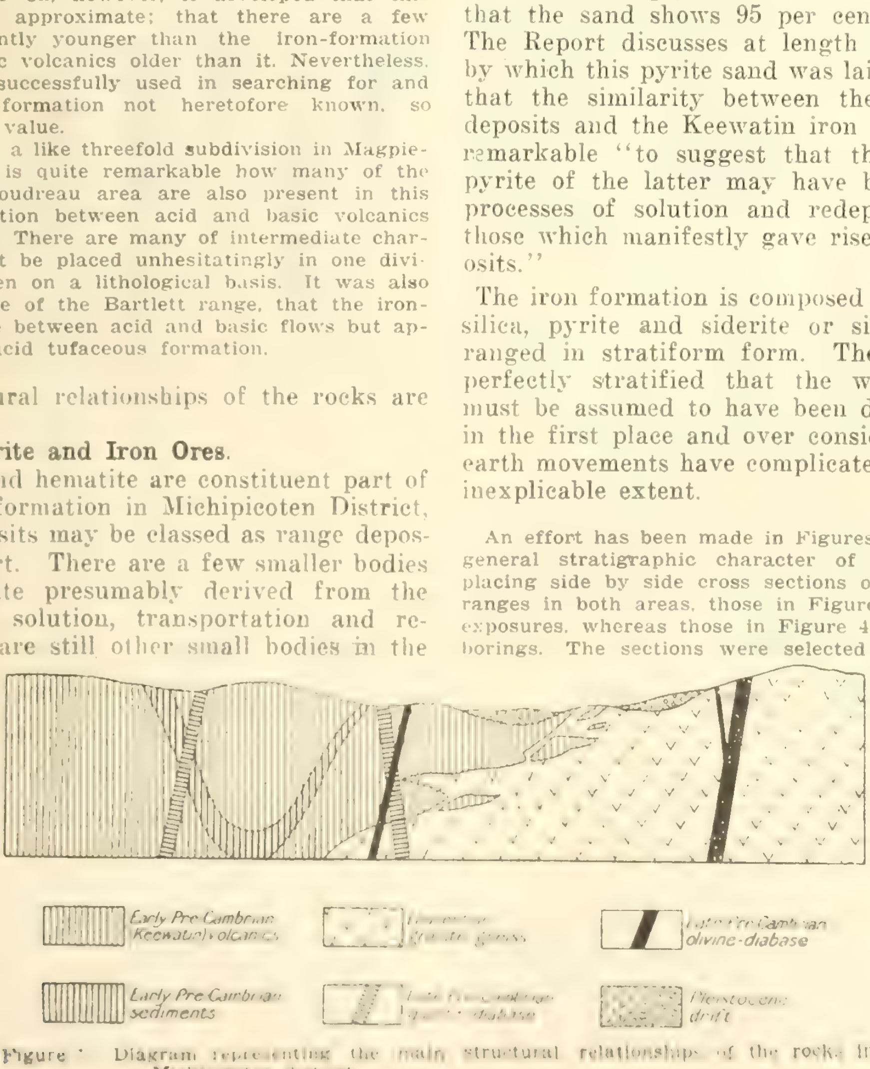


Figure 1. Diagram representing the main structural relationships of the rocks in Michipicoten district.

sentative as possible of the principal ranges examined. They do not, however, illustrate such extreme types as the body of siderite at Leg lake, Magpie-Hawk area, or the Dreany range, near mile 182 on the railway, which consists solely of banded silica.

The iron ranges vary in thickness from about 2 feet to 500 feet, and in apparent length from a few yards to more than 7 miles. They are associated exclusively with volcanic formations. No clastic sediments occur near them, with the exception of the conglomerate and sideritic greywacke on Parks lake, and these appear to be only a volcanic tuff modified by water action. As a rule the underlying volcanics are acid, and more or less tufaceous. The overlying volcanics are prevailingly greenstones, especially in Goudreau area, where they are also ellipsoidal but the range east of Parks lake lies in part between acid flows and tuffs. There is nothing then in the environment of the iron-formation that suggests it to be sedimentary.

The successive materials passed through in drilling in this district are discontinuous, lenticular bodies more or less complexly imbricated, and drill holes must be placed fairly closely together before the sections can be interpreted accurately. But when any range is considered as a whole (see Fig. 3) the general sequence, namely, banded silica, pyrite (or hematite), siderite, is obvious and without exception, whether all three or only two members are present.

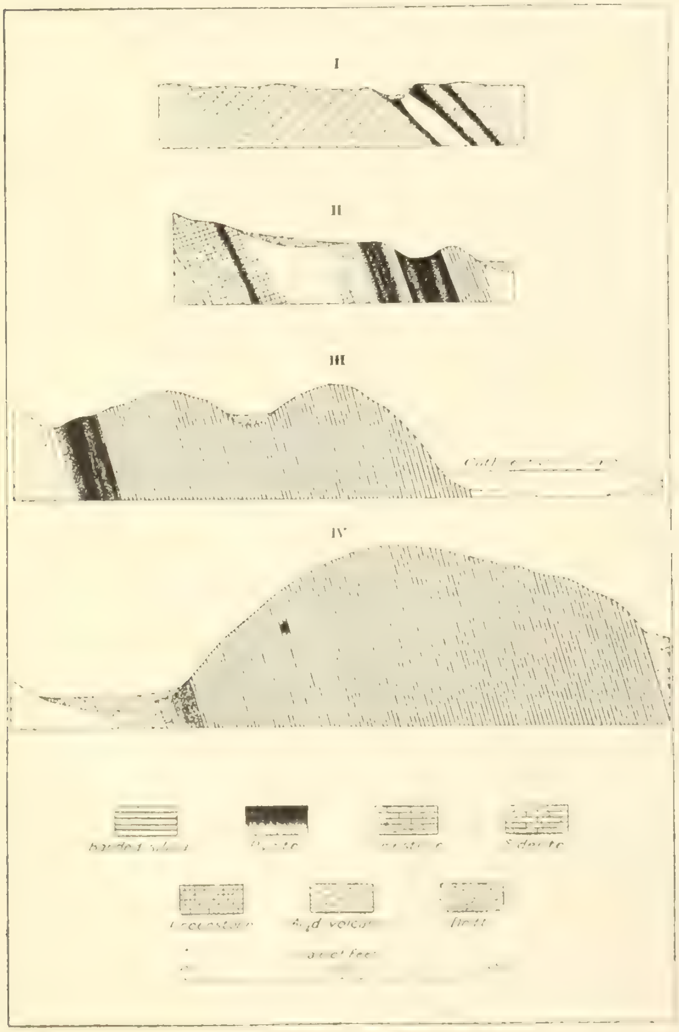


Figure 3. Cross-sections of iron formations showing the stratigraphic arrangement of banded silica, pyrite, and siderite, or sideritic limestone, and the topographic expression of each. 1. Near middle of mining location J. L. 10, Goudreau area. II. Along east boundary of mining location A. C. 39, Goudreau area. III. Near east end of Cuthbertson lake, Magpie-Hawk area. IV. Near middle of the Bartlett group, Magpie-Hawk area.

Among the properties described are those of the Nichols Chemical Co. lying immediately north-east of Goudreau Station on the Algoma Central, where in 1918 ore was being taken at the rate of 150,000 tons for the season, and 300 men were employed.

The Rand Consolidated Co. holds properties which are a continuation of the Nichol Company's main range known as the Morrison No. 4 Group. Another property owned by this Company is the Morrison No. 2 on which are two parallel iron ranges, on the southern range of which much diamond drilling has been done along a distance of 3,800 ft. These holes show a pyrite deposit ranging in thickness from 12 to 50 ft. at a depth of from 60 to 200 ft., which, assuming the ore body to be continuous between the holes, would indicate a probable ore content of 1,250,000 tons. The drill-core analyses are not available but it is intimated that a large part of the ore may not contain more than between 25 to 35 per cent of sulphur.

Considerable space is devoted to a description of the Josephine Mine, which is too long to quote here.

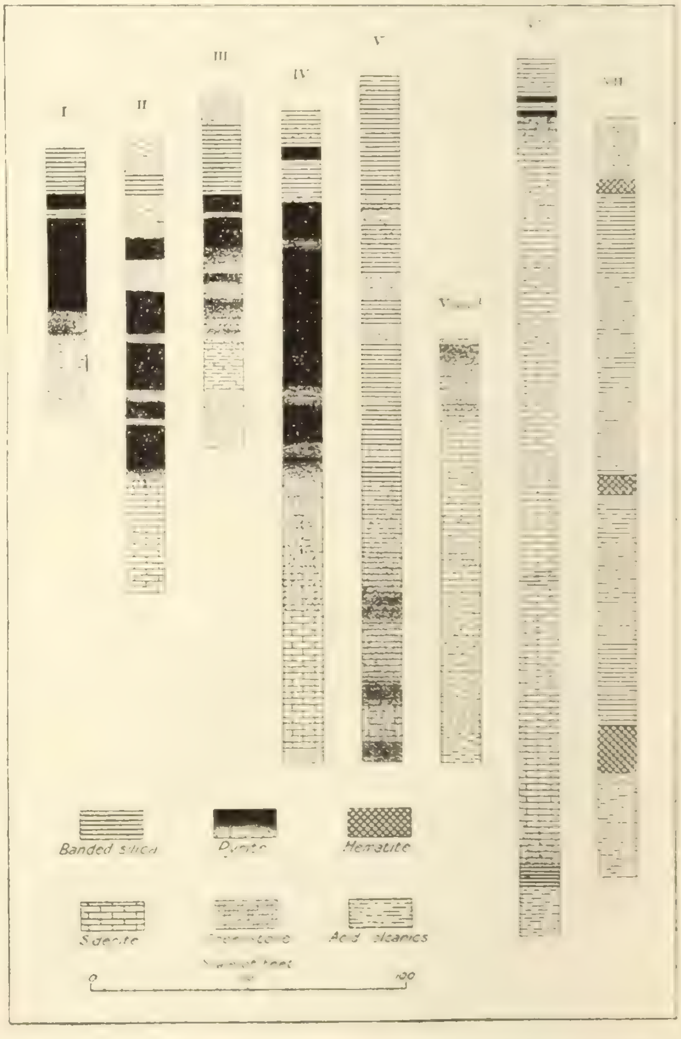


Figure 4. Diamond drill sections of iron formations showing in more detail than Figure 3 the stratigraphic arrangement of banded silica, pyrite, and siderite, or sideritic limestone. The drill logs have been corrected so as to show true thickness in each case. I. Hole No. 15, C deposit, Nichols Chemical Company's property, Goudreau area. II. Hole No. 8, Morrison's No. 2 property, Goudreau area. III. Hole No. 16, Morrison No. 3 property. IV. Hole No. 8, Morrison No. 1 property. V. Hole No. 1, Bartlett property, Magpie-Hawk area between 950 feet and 30 feet. VI. Hole No. 111, Helen mine, Magpie-Hawk area between 450 feet and 850 feet.

Thirteen drill holes are said to have been put down, which indicate the presence of an oval area of iron ore, which, if reckoned on a basis of all ore carrying over 30 per centmetallic iron, would give an estimated content of 2,250,000 tons of hematite, or 1,300,000 tons at a 50 per cent metallic iron basis. At least 850,000 tons is believedto be recoverable.

J. COUGHLAN & SONS OBTAIN CONTRACT AND SUBSIDY OF SECOND-CLASS GRAVING DOCK AT VANCOUVER, B. C.

The department of Public Works has issued the following statement:—

"The Government has recently had under careful consideration the applications submitted for the construction of a drydock in the harbor of Vancouver under the Drydocks Subsidies Act, and it has been decided to approve of the application of Messrs. Coughlan and Sons., Ltd. Their application is for a second-class graving dock of the following dimensions:

"Length from caisson top to head wall, 725 feet. Length from back of sill to head wall, 700 feet.

"Clear width of entrance at bottom, 110 feet. Depth over sill at high water, O.S.T., 30 feet.

"The minimum dimensions for drydocks of the second class as fixed by the act are as follows: Length from caisson groove to head, 650 feet. Clear width at entrance, 85 feet. Depth of water over sill at high water O.S.T., 30 feet. Depth of water over sill at ordinary low water in non-tidal waters, 25 feet.

"The dock proposed by the Coughlan Company is, therefore, considerably larger that the standard dimensions of a second class dock.

"An important consideration in granting the application was the fact that this dock can accommodate the largest vessels on the Pacific coast, plying between Vancouver and the Orient. The two largest are 590 feet long and 68 feet wide. The width of the entrance to the proposed dock is the same as the width of the Panama Canal docks.

Favourable Conditions.

"The subsidy on docks of the second class is four and one-half per cent on a maximum of $2,500,000 for a period of 35 years, or $112,500 annually. The subsidy to first class docks is 4½ per cent on a maximum of $5,500,000 for 35 years or $247,500 annually. The Government, therefore, by deciding on the Coughlan application, saves an annual sum of $135,000, which represents, at five and one-half per cent, a capital investment of $2,254,000, and at the same time secures a dock for the port of Vancouver which is capable of taking care of any shipping on the Pacific Coast.

"Attention is also drawn to the fact that this is not the only provision which the Government is making for shipping on the Pacific Ocean. It is also constructing as a Government undertaking, a first class graving dock in the harbor of Esquimalt, near Victoria, B. C. This dock will have a length of 1,130 feet and a depth of water over all at high water sill at high water, ordinary spring tides, of 38 feet. It must not be forgotten that the Government already owns and operates a graving dock at Esquimalt, 430 feet long with a 65 foot entrance, and a depth over the sill of 26½ feet, so that, with this existing dock and the two new magnificent docks above referred to, the Western Canadian seaboard will be splendidly equipped.

"One of the conditions of the Government's acceptance of the Coughlan Application is that they commenced work within thirty days from the date of the subsidy agreement."

OBITUARY

R. H. Brown

With the passing of Mr. R. H. Brown, of Halifax, is severed a link with past history of the coal and associated steel industries of Nova Scotia.

Mr. Brown was the son of Richard Brown, who came from England to be the manager of the General Mining Association in 1826 and continued in that position until 1864, when he retired and was succeeded by his son, who administered the Association's affairs until its properties were acquired by the Nova Scotia Steel Company in 1900. Mr. Brown continued to act as Manager for the new Company until 1901, when he retired from active management. A continuous administration by father and son for seventy-five years is worthy of record.

No two single men have left a more enduring mark on the coal industry of Nova Scotia than Richard Brown and his son. Both were men of great industry and of little personal display.

Mr. R. H. Brown was President of the Mortgage Corporation of Nova Scotia, and was at the office when he was seized by a fatal illness at the age of eighty-two years. Notwithstanding his age, Mr. Brown was an active man and usually walked to his appointments. He was a modest kindly man, and generous in his support of good causes.

In recognition of his long standing in the mining profession and of his length of membership, Mr. Brown was a few years ago made an Honorary Member of the Mining Society of Nova Scotia. Under his direction some of the earliest submarine coal-mining in Nova Scotia was undertaken, and several historical papers by Mr. Brown are included in the Transactions of the Mining Society. With his death comes a break in the long tradition that links coal-mining in Nova Scotia to such notable names of past years as the older and younger Haliburton, Lyell, Dawson, Logan, and last but not least in the regard of students of the early days of Nova Scotian geology and mining, Richard Brown, the elder.

BRASS COMPANY EXPANDS

Plans have been prepared for a new foundry 138 by 58 feet for the Galt Brass Company, at Galt, Ont. An extension will also be added to the vitriol plant which will be 90 by 40 feet. Both buildings will be of concrete, steel and brick construction and work will be started as soon as weather permits. This is the third time in four years that the company has found it necessary to expand.

IRON AND STEEL IN AUSTRALIA.

Mr. David Baker, General Manager of the Broken Hill Proprietary Company's Steel Works at Port Waratah, N. S. W., Australia, giving evidence on the necessity of a fresh-water supply for steel-works, uses said that the steel industry in Australia was just beginning. They were today employing 4,200 men, but in 10 or 15 years the number employed by the Company would reach 10,000 or 15,000 persons. Sydney, Nova Scotia, people will remember Mr. Baker, as General Manager of the Dominion Iron and Steel Company in the early nineteen hundreds.

The Dominion Steel Corporation

During the calendar year 1919 the production of the Dominion Iron & Steel Company was lower throughout all departments, because of the partial idleness of the works during the Summer and the lack of orders. Particulars of output during the years 1918 and 1919 are as follows:

	1919	1918
Coke	349,000	471,000
Pig Iron	223,000	289,000
Steel Ingots	254,400	330,000
Blooms	203,000	271,000
Billets	55,000	70,000
Rods	40,700	46,900
Rails	110,400	115,800
Pit Rails	2,407	
Merchant Bars	400	28,200
Nails	9,470	6,590

Collieries.

Cape Breton	3,090,000	3,271,755
Springhill	293,000	367,557

During the year the Steel Company put into operation two new batteries of coke ovens, which were described in "Iron & Steel" of the December issue. These ovens have shown much efficiency in operation, and are a great technical improvement on previous coking installations at Sydney.

Also during the year there was completed a 110 inch ship-plate mill, for a description of which see the January issue of this periodical. This mill was put into operation on the 19th February, in the presence of the Deputy Minister of Marine and other invited officials of the Department. Work is now proceeding on the government contract for plates, and about 130 men will be employed on the mill for the time being.

Production at the Sydney plant has not yet reached a maximum. A rail order for the Roumanian Government is being rolled, but up to the 18th February the blooming mill has been running on single-shift. It has now been placed on full capacity of two shifts. Announcement has recently been made that available orders exceed the capacity of the Plant.

At the end of January, the Steel Company announced a general advance in wages, equivalent to an average of 10 percent on the whole of the plant employees, and retroactive to the first of January.

Very considerable interest is felt in the Sydney district in the creation of an advisory board in London, composed of representatives of the largest steel making and shipbuilding enterprises in the United Kingdom.

Eminent mining engineers and steel experts have recently examined the ore mines, the collieries and the steel plant of the Dominion Steel Corporation, and have also visited the ore mines, collieries and steel plants, car-works and shipbuilding plant of the Nova Scotia Steel Company. Examination was also made of the Halifax Shipyards plant, described in this issue.

It is generally assumed that the British interests have acquired a sufficient holding in the Dominion Steel Corporation to enable them to propose schemes for consolidation and enlargement of the associated coal, iron and shipbuilding industries in the East. Whether this be so or not, the obvious desirability of such a consolidation cannot be questioned. The combined value of the iron-ore, limestone and coal deposits; lumber properties, steel plants and rolling mills, shipbuilding yards, and terminal properties for loading, discharging and warehousing, owned by the two large steel companies in Nova Scotia, would be very much greater than the sum total of their equities when separately operated. The interdependent and complementary character of these properties can not escape the impartial examination and appraisal of competent and unprejudiced observers, and if it should be that the powerful British interests which are now looking into this question are in a position to decide the policies of the companies in question, it may be taken for granted that the process of examination will reveal the indubitable wisdom of thorough going consolidation of operation and direction.

CANADA SUPPLIES OWN PLATES.

Based upon the export figures for the first three quarters of 1919, Canada was the second largest purchaser of American steel plates, importing 144,800 tons against Japan's purchases of 191,000 tons. Canada's consumption of plates has increased gradually from 9,700 tons a month in 1916 to approximately 16,000 tons.

This sustained demand, which has not followed the downward trend of other exported articles to the Dominion, is largely due to the activities of its ship building industry. Only two modern steel shipbuilding yards were in operation in Canada before the war, whereas at the present time there are 14 situated not only on the Atlantic, but on the St. Lawrence river and Pacific coast. The entrance of the government as a factor in ship construction has had a decided influence on the industry. The Imperial munitions board, acting as the agent of the British government, placed orders for ships amounting to over $70,000,000. In addition to this the Canadian yards received a fresh impetus through the action of the Dominion government in launching an extensive shipbuilding program, which has led to the building of 60 cargo vessels of approximately 360,000 tons, deadweight.

Whether Canada will continue to be a heavy buyer of American steel plates depends on what steps are taken to establish a home steel industry. A tendency toward this end is seen in the recent installation of a 110-inch plate mill by the Dominion Iron & Steel Co., Sydney, N. B., practically under government guarantee. This mill will have a nominal capacity of 12,000 tons per month, which is almost adequate for the present needs of the country. Canadian steelmakers declare that as yet there is no place in the commercial life of the Dominion for the private operation of a plate mill of this size unless it is aided by the government, either by subsidies or by the latter bearing part of the cost of construction. Therefore, the future export of plates from the United States will depend largely upon the extent to which the Canadian government protects its infant ship plate industry.—Cleveland "Iron Trades Review."

The Algoma Steel Corporation

Through the courtesy of the President of the Algoma Steel Corporation "Iron and Steel of Canada" is enabled to give some particulars of the progress of this Company in recent years.

During the war period much was accomplished in extending and building up the Plant and its equipment. This included additional coke ovens (for a description of which see the issue of November 1919) the elimination of the Bessemer process in favour of the open-hearth process, and the installation of an additional blast furnace, formerly the larger furnace of the plant of the Canadian Iron Corporation of Midland, Ont.

The demand for steel was not large until the last quarter of the year, but there has been a rapid revival of demand, and at the present time it is equal to the closing period of the war. All lines, both in iron and steel, are in request. The effect of the steel strike in the United States, followed by the coal strike, has much increased the Canadian demand, and the Algoma Company has even sold some of its products in the United States.

The Company has branched out into new lines of production, the most important of which is the manufacture of structural steel shapes up to 15-inch beams and channels.

Alloy steels of various kinds are being produced, and there is quite a demand for the product.

In the opinion of Mr. Frantz the outlook for the future of the Canadian steel industry is better than at any time in the past, and with the natural growth of the country it is to be expected that enlargement of all the existing steel plants will be found necessary This condition is one that applies to the immediate future and the more remote future also.

Announcement is made of the immediate undertaking of construction work on a new structural-steel milll by the Algoma Steel Corporation at Sault Ste Marie, at an estimated cost of between six and seven million dollars. Work is reported as already in progress on the clearing of the site.

About ninety per cent of the structural steel used in Canada is imported, the United States supplying in average years probably about ten million dollars worth of material of this class. In 1913 the imports reached a value of thirteen million dollars. The Algoma Steel Corporation hope to supply much of Canada's future needs from the projected mill at the Sault. It is anticipated the mill can be completed for rolling in from twelve to fifteen months, and much of the construction material the Corporation hopes to supply from its own plant. There are at present four blast furnaces available to supply the raw material.

It is expected that 500 men will be employed on construction work during the Winter, increasing to 1,000 next Summer. The completed mill in operation will employ about 600 operatives. The immediate financing of the venture is made easy by the possession of ready cash and other liquid funds of the Corporation. The last annual report showed current assets of $13,834,842, with current liabilities of $2,449,790. In the last report of the Board the following statement was made:

"During the past twelve months the services of capable constructing engineers were secured to prepare engineering plans for a universal mill, consisting of a 40-inch blooming mill, 36-inch rougher and three stand 28-inch combination structural and rail-finishing mills, all motor driven. This mill, in addition to rolling beams and channels up to 24 inches will be able to roll a substantial steel-rail tonnage to meet the increasing demand for heavier and longer rails.

"Your directors are well satisfied that not only is there prospective business to warrant the proposed new construction but that the new mills of the kind contemplated are vital to the continued success of the Steel Company. It may be mentioned that at the present time Canada imports all structural steel and shapes in excess of 35 lbs. per yard."

MR. J. D. JONES APPOINTED GENERAL MANAGER OF ALGOMA STEEL CORPORATION.

Announcement is made from the office of President W. C. Franz, of the Algoma Steel Corporation, that Mr. J. D. Jones, who, since last September, has been General Superintendent, of the Algoma Steel Works, has now been appointed to the position of General Manager, in succession to the late Captain David Kyle. From 1912 to 1916, Mr. Jones was employed by the Algoma Steel Corporation, but in 1916 he left the Sault to take the position of Chief Engineer in the United States Steel Corporation's plant at Gary, Indiana. Last September he again returned to the Sault to join the staff of the Algoma Steel Corporation.

W. C. FRANZ, PRESIDENT ALGOMA STEEL CORPORATION

The Production of Pig-Iron, Steel and Ferro Alloys in Canada from 1913 to 1919

(Collated from Statistics of Mines Dept. Ottawa
1919 figures are estimated.)

	1913	1914	1915	1916	1917	1918	1919
Pig iron from blast furnaces..	1,128,967	783,164	913,775	1,169,257	1,156,789	1,163,520	
Pig iron from electric furnaces..					13,691	32,031	920,000
Steel ingots..	1,126,750	811,567	981,859	1,378,803	1,691,291	1,800,171	
Steel castings..	39,217	15,315	28,384	23,496	54,443	73,537	1,020,000
Electro steel, incl. some castings..	3,026	1,759	10,653	25,950	50,467	119,130	15,000
Ferro alloys..	8,075	7,524	10,794	28,628	43,465	44,704	47,000
Steel rails..	554,481	428,226	232,411	90,123	46,645	162,747	316,304

D. H. McDOUGALL.
President of the Canadian Mining Institute, 1919-1920.

The Electric Steel and Metals Co., Limited, Welland, Ont.

The manufacture in Canada of high grade electric steel received considerable impetus during the war, and while the old established Steel Companies operating open hearth furnaces contributed, by far, the larger tonnage of munition steel, the electric furnace generally won a place for itself in districts where sufficient power could be obtained, at reasonable cost. The high quality of electric steel, already demonstrated in Europe and the United States, has now been fully recognized in Canada and where engineers specifications call for the highest quality of either carbon or alloy steels the electric furnace product is found to meet requirements, without difficulty.

STEEL CASTINGS MADE BY ELECTRIC STEEL & METALS CO

A few years ago alloy steels were, to say the least, looked upon as something of a novelty, and many "old line" steel experts were extremely reticent to accept the astonishing results that were claimed for these, so called at that time, new-fangled steels. Nevertheless, the alloy steels had arrived and today the manufacture of carbon steel is unimpressive in comparison with the rapid advancement in knowledge and equipment enjoyed by the alloy steel industry.

The steady increase in the number of electric furnaces may be said to have fostered precision in steel making and without disparaging the older processes, has added stimulus to the attainment of the best possible product to meet special requirement.

Electric steel when manufactured under approved conditions, possesses a quality that is paralleled only by the best crucible steel and because the electric furnace possesses larger unit capacity, and when basic lined enjoys the option of refining, it may eventually win from the crucible process, the premier position so long held by the latter, for the production of steel of high quality.

The Electric Steel and Metals Company, Limited, of Welland, Ontario, incorporated 1913, completed the installation of its electric steel foundry in the spring of 1914, and shortly after the commencement of the Great War, undertook the manufacture of shells and shell blanks for the British Government. The Company continued to manufacture munition steel throughout the war and established an enviable reputation for itself as regards the quality of its products. During 1917, the Electric Steel and Metals Company, Limited was consolidated with the Boving Hydraulic and Engineering Company, Limited, of Lindsay, and the Wabi Iron Works, Limited, of New Liskeard, under the name of Electric Steel and Engineering, Limited, which owns and controls the three subsidiaries, from its head office in Welland, Ontario.

In the late fall of 1918, the Armistice brought the manufacture of munition steel to an end, as far as the Electric Steel and Metals Company, Limited was concerned and the management then directed its efforts to equip the foundry more completely for the production of forging ingots and steel castings. With the termination of hostilities the plant consisted of a

steel foundry approximately 80' x 500' and a parallel building 50' x 400' subdivided into pattern shop, machine shop and fettling rooms. A large well appointed office, is situated in a separate building.

The foundry is equipped with two 7-ton Herault steel furnaces of modern type and these furnaces, while only designed to hold 7 tons of steel have been charged with over 11 tons or scrap when large heats were required for special purposes.

The moulding department is equipped with large dry mold and core ovens, sand mixers, etc., etc., and occupies a floor space of 650' x 200'. A special feature is a large concrete casting pit twenty feet deep for the purpose of making forging ingots or long castings that must be cast on end. The foundry is served by two overhead electric travelling cranes of capacity to meet present requirements.

Ordinary castings are made to the specifications of the American Society of Testing Materials, unless otherwise specified. Special casting of high carbon, or any required alloy steel castings can be made to specifications if ordered in sufficient quantities. Manganese steel castings of first class quality, equal to any imported brand are being made in increasing quantities as consumers are convinced of the wearing qualities. Forging ingots of dead killed carbon and alloy steels are being supplied to Canadian forging plants, who report favorably regarding the forging quality of these steels.

All steel manufactured is rigidly examined both by chemical analysis and physical test, the laboratories of the steel melting department being under the direct supervision of an experienced metallurgist who

TWO SIX-TON HEROULT FURNACES IN PLANT OF ELECTRIC STEEL & METALS CO. WELLAND, ONT.

The annealing department is well equipped with modern oil-fired car type annealing furnaces, and suitable quenching tanks are installed for the annealing of manganese steel castings.

The cleaning and fettling department is provided with a modern "Sly" sandblast room, a full line of swing and stationary grinders and all the usual air chipping, hammers. An electric welding outfit is also installed in the cleaning department.

The machine shop and pattern shap are of the usual type and require no special comment. They are of ample capacity to meet all requirements of the plant for some time to come.

controls all operations effecting the chemical and physical quality of the steel.

The plant is turning out at the present time over 100 tons of casting and 50 tons of forging ingots and has ample capacity to manufacture 300 tons of castins and 700 tons of forging ingots monthly.

The plant is manned with a working staff that would be difficult to duplicate in any similar industry, all hands being imbued with the idea of giving the best of service in order that the product shall be of the very highest quality and that customers may feel confident of honest and intelligent co-operation.

STEEL ROLLS MADE BY ELECTRIC STEEL & METAL CO.

SMELTER LEAD-POT. STEEL CASTING WEIGHING 18,000 LBS
MADE BY ELECTRIC STEEL & METALS CO.

CANADIAN MEAD-MORRISON CO. LTD., WELLAND, ONT

The Canadian Mead-Morrison Company Limited has been organized under Canadian laws, and has purchased the manufacturing plant of M. Beatty & Sons at Welland, Ontario, and has also purchased the Canadian business of the Mead-Morrison Manufacturing Company of Boston, New York and Chicago. Steps have already been taken to enlarge and improve the Welland plant, and the new Company will manufacture the extensive line of well-known "Mead-Morrison" products as well as the Beatty line of Dredges, Derricks, Hoists, Pumps, etc.

The new Company has acquired from the United States Company the rights to use their engineering data, plans, patents, and past and future development work. This enables the Canadian Company to start under the most favourable auspices.

MR. D. W. COE, GENERAL SALES MGR. CANADIAN MEAD-MORRISON CO.

The Canadian Mead-Morrison Co. Ltd. has already a large specially trained Engineering staff, and a well organized Contracting Department, and is in a position to submit specifications, tenders, and to execute contracts for complete labour saving plants.

In addition to covering the Dominion of Canada, the Canadian Company will also manufacture for export to the British Possessions.

The "Mead-Morrison" installations are well-known in Canada, and among the large plants in successful operation might be mentioned those built for the Canadian Pacific Railway, Canadian Northern Railway, Canadian Government Railways, Grand Trunk Railway, Canada Cement Company, Steel Company of Canada, Nova Scotia Steel & Coal Company, Montreal Light, Heat & Power Company, St. Lawrence Stevedoring Company, Canada Sugar Refineries, St. Lawrence Sugar Refineries, St. Lawrence Bridge Company, Canadian Rolling Mills, George Hall Coal Company, Ogdensburg Coal & Towing Company, Farquhar Robertson Coal Company, Canadian Furnace Company.

In addition, the "Mead-Morrison" hoists, both steam and electric, have been used extensively by the large contracting firms operating in the Dominion of Canada.

The Company has also furnished installations in England, Australia, Chili, Brazil, Norway, Sweden and Cuba.

The new Company will have a very strong local Board of Directors, and its general officers will be Messrs. W. S. Martin, Managing Director; D. W. Coe, General Sales Manager; J. R. Story, Chief Engineer; and J. A. Johnson, Secretary.

The General Sales Offices of the Company are located in the Guarantee Building, 285 Beaver Hall Hill, Montreal. This Office will have entire control of the sales of "Mead-Morrison" products in the Dominion of Canada and British Possessions. The sales are divided into two classes—Engineering Contracting, which covers the installation of Coal, Ore and Material Handling Plants, and Merchandise Sales, under which heading are included the standard lines of Steam and Electric Hoists, Contractors' Equipment, Grab Buckets, Derricks, Winches, etc.

The Engineering Construction Department is under the direction of Mr. R. C. Smith, of Montreal.

Mr. D. W. Coe, General Sales Manager, of the Canadian Mead-Morrison Company Limited, has been connected with the Mead-Morrison Manufacturing Company for a number of years and is well known in Canada, as the many large "Mead-Morrison" installations in Canada were made under his direction as Manager of the Boston Contract Department of the Mead-Morrison Manufacturing Company.

Mr. Coe is very enthusiastic on the subject of Canadian prosperity, and thoroughly believes in the future of Canada as a manufacturing country. He is building up a strong organization of Canadians, and sees a great future for "Mead-Morrison" products "manufactured in Canada."

CANADIAN LOCOMOTIVE COMPANY RECEIVES LARGE ORDER

The Canadian Locomotive Company, whose works are at Kingston, have recently taken orders for locomotives which will keep the works going until after the end of the year 1920.

These orders total 33 engines, 20 of which are for the Canadian National Railways, three for the British Columbia Government for the Pacific and South Eastern Railway, and 10 for the Jamaican Government. The prospects of the company appear to be exceedingly good under the present demands for equipment.

The Dominion Bridge Co. and Subsidiaries

This history of the Dominion Bridge Company, and its subsidiaries during the past decade is an epitome of the development of the metal trades in Canada during that period.

Before the war the regular business of Dominion Bridge was bridge building, the fabrication and erection of structural steel for roofs and framing, travelling cranes, sluice gates, etc., and during its thirty years of experience up to the outbreak of war, the Bridge Company had played an important part in the orderly development of Canada's communications and industrial expansion.

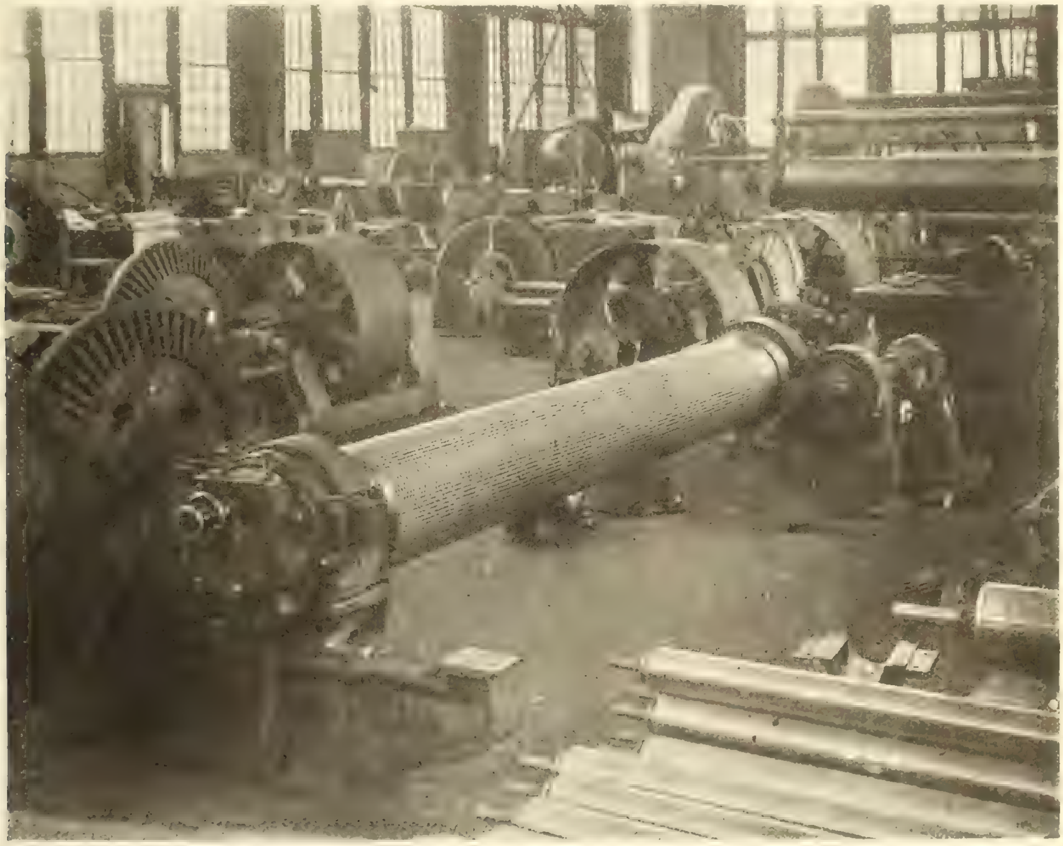
During the war period this Company was one of the first to adapt its equipment to the necessary work of munitions manufacture, and so expanded its operations that a number of subsidiary companies were formed including the Dominion Ammunition Company, the Dominion Copper Products Company and the Dominion Crucible Co. The operations of this last-named Company were described in our January issue. The associated companies produced large quantities of finished shells and cartridges cases, and forgings, full particulars of which have been previously made public.

Later, when submarine destruction necessitated that Canada should commence the erection of ships, an industry that has been too long deferred, irrespective of war conditions altogether; the Bridge Company undertook the building of ships' engines and boilers. Arrangements were also made with the U. S. Ship building Corporation to fabricate parts for the standardized ships that were to be assembled at the Hog Island Yards, and some thirty thousand tons of fabricated material was turned out of the Bridge Company's shops for this purpose.

The simultaneous engagement of the energies of the officers of the Bridge Company in the erection of the Quebec Bridge, and the successful accomplishment of that unique feat is a matter of general knowledge and interest to engineers, but the really outstanding character of this achievement in Canadian annals has not been understood by the public at large.

With such record behind it as has been roughly sketched in the foregoing, it will be realised that the organisation and equipment of the Bridge Company is a strong and capable one. The postponement of construction programme during recent years promises a busy time ahead for the structural shops of the Company, and it is unusually well placed to fill requirements because of the strengthened character of its technical organisation, its comfortable financial position, and the extent of its stocks of steel and advantageous contracts for future deliveries.

A further enlargement of the Company's operations, which again reflects the development of the country, is occasioned by the demand for paper-making machinery in Canada. The Company has brought out the shops and equipment of the St. Lawrence Bridge Company, built originally for the fabrication of the Quebec Bridge, and for the purpose of seggregating the more mechanical portion of its business from the original structural steel operations, has formed a new subsidiary, the Dominion Engineering and



PAPER MAKING MACHINERY IN COURSE OF ASSEMBLAGE IN THE SHOPS OF THE DOMINION ENGINEERING & MACHINERY CO., LACHINE, QUE.

Machinery Company to carry on the new branch of paper machinery manufacture. A foundry has been equipped and is now in operation, and the machine shop is nearing completion.

The Maritime Bridge Works at New Glasgow, Nova Scotia, and the Robb Engineering Works at Amherst, N.B., are controlled by the Dominion Bridge Company, in addition to branch offices and works at Ottawa, Toronto and Winnipeg.

The management of the Company, as will be seen from the foregoing, has combined engineering ability and foresight as to the needs of Canada, with a keen appraisement of the commercial opportunities, a policy that promises permanence and financial stability.

THE UNION DRAWN STEEL COMPANY OF HAMILTON, ONT.

The specialty of this Company is bright drawn finished steel. Operations were commenced in 1905, when Canadian requirements of this material were not great, and the original plant was designed to produce about 3,000 tons of finished material annually. Expansion has been gradual until, during the war period, and since a production of from 12,000 to 15,000 tons a year has been usual. The employees now number over one hundred, and the Company plans extension of its facilities.

Recently, the Company has arranged a life insurance policy for each of its employees having three months or longer of continuous service in the Company. The amount of the free policy given is graded from $750 for those having less than one year's service, up to $1,250 for those having five years and over. The application of the policy is retroactive, and is reckoned as to grading from the date of entrance into the Company's service.

The announcement of the Company's intention to grant this policy was accompanied by a letter stating that the health, happiness and co-operation of its employees was uppermost in the minds of the Directors and had inspired their action. Such consideration of employees is not only commendable, but will bring its own certain reward.

EASTERN CAR COMPANY OBTAIN LARGE CAR ORDER.

The Eastern Car Company of New Glasgow, a subsidiary of the Nova Scotia Steel and Coal Company has ben awarded a contract for the construction of 1,000 cars for the Canadian National Railways, comprising 500 box-cars and 500 general service cars. This order, with other orders pending and anticipated assures steady work for the Car Plant during the remainder of the year. This Company has recently constructed some very fine steel snow-plows for the Canadian National Railways, and also a number of charging cars for the new plant of the British-America Nickel Company at Ottawa.

Freyn, Brassert & Company, Engineers, Peoples Gas Building, Chicago, have made arrangements with the Gellert Engineering Company of Philadelphia, for the mutual handling of Cottrell electrical blast furnace gas cleaners for the entire world.

Freyn, Brassert & Company will have exclusive charge of sales and will cooperate with the Gellert Engineering Company who are the exclusive builders of the Cottrell cleaner in the United States in the installation and practical adaption of his apparatus to the particular requirements of blast furnace practice.

The Cottrell gas cleaner is of the dry type and functions by means of electrical windage giving no back pressure and entailing no loss of sensible heat.

It is at present in successful use in this country and abroad, giving excellent results as to cleanliness of gas, simplicity of operation and recovery of byproducts.

PLANT OF THE EASTERN CAR CO., NEW GLASGOW, NOVA SCOTIA
(A Subsidiary of the Nova Scotia Steel & Coal Company)

THE MINERAL AND METALLURGICAL INDUSTRIES OF CANADA AND CUSTOMS TARIFF.

The guiding principle in the policies of the farmers' organisations in Canada is the immediate financial betterment of the farmer through decrease in taxation and the lessening of the price of agricultural implements and accessories by the abolition of protective tariffs. Mr. T. A. Crerar has publicly stated: "I would absolutely root out the principle of protection in our customs tariff."

In a straightly drawn issue between the merits of free trade versus protection there is no discharge in the war of argument, and unfortunately persons who have strong convictions on either side appear to draw these convictions from a natural preference, or perhaps it should be called a prejudice, which takes no account of economic facts. These prejudices partake of the nature of religious leanings, or they may be likened to the incompatibility of temperament between the prohibitionist and the non-prohibitionist. It is as useless, and as profitless to indulge in academic argument concerning free trade as compared with protection as to argue about many other matters that are merely a reflex of two eternally opposed types of human nature.

Unfortunately those whose business is connected with the production of minerals and their utilisation in Canada must reckon with economic facts, chief among which is that the two most important branches of Canadian mining and metallurgy, namely, the production of coal, iron, nickel and various ferro-alloy materials, and their utilisation in the arts on the Canadian side of the border, are based upon protective tariffs. This is a fact that is thoroly appreciated by the farmers in the East, which accounts for their disapproval of the root and branch condemnation of all forms of protection favoured by the western farmers. The day is coming when this conflict of agricultural opinion will be cured by the industrial development of the West itself. When the enormous coalfields of Alberta are developed on a scale somewhat commensurate with their extent, then we may expect to see the industrial activities of the West exceed the industrial activities of the East in the proportion that the fuel supply of the West exceeds that of the East. The possession of coal spells commerce industry, political power and purchasing power. Coal is the most important commodity in modern civilisation. Its value exceeds that of agricultural products, because witout coal large agricultural production is impossible, seeing that neither the provision of modern implements or transportation are possible in the absence of coal. The cure for the single and very selfish vision of the western farmer is the admixture of manufacturing industries with grain raising, and this will come in time.

Meanwhile, however, there is a grave danger that in order to reduce the cost of farm implements the farmers' parties may be willing—if they obtain the power—to chance the destruction of the established industries of Canada, on which the purchasing power and wealth of our population depend. If the farmer thinks that he can escape the effects of the financial depression which would cover Canada from coast to coast were protective tariffs completely abolished, he is much mistaken. The price of wheat would fall, and even at reduced prices would be beyond the purchasing power of Canadian industrial workers. The facts are so inescapable that, should the farmers' parties control Canadian politics, it may be expected, when faced with the actual responsibility, that they would do as many other parties with similar aims have done in Canada, and decide that they dare not risk the commercial desintegration of Canada to achieve a temporary saving in a few selected agricultural accessories, and to test a pet political theory.

There should be no ambiguity among the mining men of Canada as to the protected nature of their industry. The fact should be freely and frankly admitted, and the necessary steps should be taken to safeguard the industry when tariff changes are proposed. We believe also that the industry should look at the largest aspect of the question, and should not urge the exemption of tariff duties upon some specialised and selected equipment needed in mining operations, without fully realising that the basic mineral and metallurgical industries are all protected by tariffs, and that requests for small and relatively unimportant exemptions on mining equipment, may effectively weaken and vitiate a principle that works to the benefit of the larger interests of mining men as a whole.—From "Canadian Mining Journal."

PRODUCTION OF IRON AND STEEL IN GREAT BRITAIN.

The following figures, compiled by the National Federation of Iron and Steel Manufacturers, gives the output of pig iron and steel ingots during 1919.

	Pig iron Tons.	Steel ingots. Tons.
January	664,000	718,000
February	625,000	734,000
March	684.000	758.000
April	653,000	668,000
May	632,000	755,000
June	612,000	631,000
July	660,000	618,000
August	5521,000	474,000
September	574.000	718.000
October	445,000	433.000
November	630,000	693.000
December (approx.)	640.000	680.000
Total	7,870,000	7,880,000
1913	10,260,000	7,664.000
1918	9,072.000	9.591.000

This article [illegible]

EDITORIAL

The Wabana Iron Ore Deposit

The description in this issue, by Mr. R. E. Chambers, of the sinking of the submarine slopes of the Nova Scotia Steel and Coal Company, at Wabana, Newfoundland, is of timely interest. These slopes have achieved the maximum penetration of the unique submarine iron-ore deposit, and Mr. Chambers's detailed account of the successful completion of the haulage slopes will appeal to such readers of this periodical as are engaged in the mining end of the iron and steel industry, but will more particularly interest those concerned with the operation of steel works in Canada because these slopes have definitely proved the existence and accessibility of a seam of iron ore, at a distance exceeding two miles from land, averaging from 17 feet to 30 feet in thickness.

The Wabana deposit has no parallel. As a coal seam, the mineral which is above all others distinguished by its regularity and persistence of deposition over large areas, the Wabana deposit would be notable for these last-named characteristics; but as an iron-ore deposit we believe it to be unique. As to the probable extent of the deposit, nothing can be said except that the probability of its continuance beyond the known limit of mining is conceded by all who have studied the deposit. It may also be added that the limit of mining has not been tested, and is therefore unknown. Col. Thos. Cantley, before the Mining Society of Nova Scotia put this aspect of the Wabana deposit with precision is stating that "The volume of ore is so great "as to present a new feature in mining, to this extent, "that it will make practically no difference, not only "to this generation, but to several generations to come, "as to what rate of extraction is carried on at Wa-"bana."

There is excellent reason to believe that the recent interest taken by large British ironfounders and shipbuilders in the steel incorporations in Nova Scotia was attracted more by a desire to acquire the Wabana iron-ore deposit than by any other reason, although additional reasons are not lacking either in number or cogency.

When large United States' steel interests commence in an impressive manner to undertake the concentration and beneficiation of the comparatively lean magnetites of the Eastern Mesaba range in Minnesota, the implication is fairly plain. The marketability of lean iron-ores is first-hand evidence of the scarcity of richer ores. The Wabana deposit is gradually coming to be recognised as one of the most impressive reserves of iron-ore of high iron-content remaining in the temperate zone.

The relative value of an iron-ore depends to a large extent on its accessibility and geographical position. As a point of distribution of iron-ore to be used within the British Empire, the position of Wabana could not be bettered. The rapidity and moderate cost with which Wabana ore could be delivered in British ports by the use of modern freighters of large capacity and quick steaming capacity is obvious, if modern unloading plants were provided in Britain.

A good deal has been mooted about the Imperial character of the motives which are said to actuate those who desire to consolidate the control of the Wabana ores, and while these motives have no doubt played their part in bringing Wabana to the attention of British statesmen following the visit of the Dominions Royal Commission to Wabana in August 1914, we venture to believe that what is really actuating the British enquiries is a realisation of the intrinsically valuable business asset that possession of the Wabana ore deposit will be to any combination of ironfounders and shipbuilders that require iron ore in very large tonnages.

Some idea of the height of the ore-seam at the point where it is tapped by the haulage slopes may be obtained from a photograph accompanying Mr. Chambers's article which shows a mechanical loader, electrically driven, but of the familiar type of boom and bucket that is chiefly associated with a railway steam-shovel, working two miles from shore.

The whole production of the Scotia slopes is today loaded into the mine cars by mechanical shovels of several types, with a negligible exception of the tonnage handled by four pairs of men.

No man has had more to do with the discovery and development of the Wabana iron-ore deposit than Mr. R. E. Chambers, and we believe the readers of "Iron & Steel" will welcome his authoritative and first-hand account of a unique engineering achievment in an ore deposit that stands alone.

IRON ORE BOUNTIES.

At the Annual Meeting of the Canadian Mining Institute the Minister of Mines for Ontario said that the Provincial Government had not committed itself to granting a bounty on iron ore, and did not feel disposed to take this course. He expressed the belief that when it became really necessary that domestic iron ores should be mined, the value of the large deposits of ore in Ontario would become apparent.

The point made by Mr. Mills lies entirely in the question as to when it becomes "really necessary" to develop our own iron-ore deposits. There is a school of thought in Canada which conceives that we should draw to the fullest extent upon the resources of the United States for the purpose of conserving Canadian resources, and the people who hold this viewpoint usually have in mind coal and iron. The fallacy in their argument is a little elusive, but we do not think it represents the most robust type of Canadian thought. Iron ore deposits, particularly those of the type found in Ontario, are not like a reservoir ready and waiting to be tapped. Their development will in any case be a slow process, and much work must be done, both in the prospecting field, in the laboratory and in the full scale experiments of the iron and steel works of Canada, before these deposits will be in a position to yield ore on a commercial scale.

As we understand it, those who are requesting a bounty desire it to be paid upon the quantity of pig-iron or steel made in Canadian furnaces from domestic ores, and, as been previously pointed out in "Iron and Steel," unless the proposal to develop Canadian iron ores is economically sound, it will not succeed, and the amount the Government would be required to disburse would in such event be negligible, whereas if the bounty were earned, the resultant impetus to industry would be such as to far outweigh and thoroughly justify the cost of the bounty.

The Minister of Mines suggested that the offer of the British Columbia Government to pay a bounty of three dollars per ton on pig-iron produced in that province from British Columbia ores had not evoked the response it should, but the offer has had one beneficial result, namely to arouse interest in the subject, and, as a direct result of that offer, there is now proceeding in British Columbia precisely that process of preliminary investigation which yields exact information, and which must always precede any worth-while commercial undertaking.

It is also fair to point out to those who believe in reserving our resources by taking immediate advantage of more advantageous conditions existing in the United States, that the possession of undeveloped resources is in the actual effect equivalent to non-possession of such resources.

There already exists in Ontario a pioneer enterprise in the beneficiation of siderite, namely at the Helen Mine. The Algoma Steel Corporation has proved the presence of immense tonnages of siderite, and has also proved the commercial possibility of its utilization by beneficiation. For its work in this direction, the Algoma Corporation deserves the thanks of Ontario.

Coming as he does from Port Arthur, where the question of beneficiation of iron ores is a live question, the Minister of Mines is probably well acquainted with the reasons urged for a bounty on iron ore, or as we believe it should be put, a bounty on pig-iron, and we trust that Mr. Mills's very definite statement that the Ontario Government does not favour such a course is not the last word on the matter. The whole question of the development of the iron ores of Ontario is worthy of study. That Canada should provide from domestic mines only 4.6 per cent of the ore fed to Canadian blast-furnaces is not a condition that should be perpetuated longer than is unavoidable.

THE LEGAL STATUS OF WORKMEN'S COMPENSATION BOARDS.

The Manitoba Court of Appeal has reversed the judgment of Mr. Justice Mathers holding the Workmen's Compensation Board to be a Court, and the appointment of its members by the Ontario Government to transgress the prerogative of the Federal Government in the appointment of judges. It is stated that a further appeal will be lodged with the Supreme Court of Canada.

The wide powers given to Workmen's Compensation Boards are disliked by lawyers, as witness the report of the Law Reform Committee of the Ontario Bar Association that the Workmen's Compensation Board of Ontario is "one of the most autocratic institutions in the Province, and absolutely independent of all government jurisdiction except by special legislative enactments."

It was doubtless the deliberate intention of those who framed the Ontario Act to make the Compensation Board an entirely independent body, charged with the duty of making decisions not subject to judicial review. This is a logical sequence to the acceptance of the root principle of workmen's compensation as viewed in Ontario, to wit, that compensation for injuries arising in and out of the course of employment is an inherent right of the workmen, not to be questioned, and, in the intent of the Act, merely assessable as to amount of compensation payment. The scale of compensation being laid down by the Act, it is held that the function of the Board is merely to disburse the sum prescribed in the schedule. As trustees for the proper disbursement of prescribed compensation payments, the Compensation Board is also charged with the collection and custody of funds raised by statutory assessment on the payrolls of employers

coming within the scope of the Act. These duties of Compensation Boards so completely dispense with the necessity for outside legal assistance that to those who have not accepted this root principle of workmen's compensation the self-contained status of Workmen's Compensation Boards presents an autocratic aspect.

It should be pointed out, however, that there are two aspects to the unreviewable nature of the Compensation Board's decisions. The Board may award compensation in cases where the employer may consider it unjustified, but may also refuse compensation to workmen claiming injury at work. If the workmen cannot prove his case he can make no appeal from the judgment of the Board, and it is understood that this is one aspect of the unappealable nature of the decisions that is objected to.

Criticism is also made of the fact that the Ontario Compensation Board—and this is true of other Boards —handles its own investments without government oversight.

There is a good deal to be said in favour of governmental audit and accounting of the accumulated funds of Compensation Boards, as these funds will in the course of years reach a very large maximum aggregate. Any such government oversight should, however, we believe, be in the direction of further safeguarding of these funds as intact accumulations of securities, and should not contemplate any merging of the funds into the general treasury of any province, nor, to anticipate a future probability, in the Treasury of the Dominion of Canada.

While, as an effective, equitable and economical method of administrating workmen's compensation, the Compensation Boards can hardly be bettered, it cannot be gainsaid that there is something repugnant to the tested traditions of British judicial bodies, or of administrative bodies charged with quasi-judicial functions, that these should not be subject to review, writ of error, or superior accounting of trust monies. Discussion of these unusual powers of the Compensation Boards is certain to grow with the growth of their duties and the funds entrusted to their care, two certainties of the future.

U. S. SUPREME COURT DECISION ON THE STEEL CORPORATION.

In "Some Considerations on Monopolies" discussed in this column in our November issue, we suggested there was "no good reason for objecting to large consolidations of capital, as such." The Boston News Bureau recently summarised the main feature of the U. S. Supreme Court decision in the suit of the U. S. Government against the Steel Corporation by the phrase: "Size no Sin." The U. S. Steel Corporation was upheld as a lawful consolidation because its monopoly had not been used to menace the State, which should serve to strengthen the hands of those who hold that the more complete the control of any industry, and the nearer that control approaches monopoly, the more economical and efficient will be the operation of the industry, and that in this respect unified control of any industry is for its general good, so long as no attempt is made to subvert legislative processes. As a means of obtaining the unified control that is necessary to ensure the fullest measure of efficiency, it will be generally admitted, after the lessons of the war period, that private control includes less evils, and is not so objectionable from the point of view of the public weal, as government control under a system of popular representation based upon the ballot.

In regard to the extension of the Steel Corporation's activities into Canada, it is fair to assume that some hesitation may have been present in the minds of those who direct the Corporation's policies, so long as the legal status of the consolidation was questioned by the government of the United States, but this uncertainty having been removed, there would seem to be no further reason for hesitation, and, seeing that the conditions which favour the extension of United States business organizations into Canada were never so powerful as they are at this time, a logical result of the Supreme Court decision may be the hastening of construction work at Ojibway. In such event, the Canadian steel companies will have to compete with the efficient forces of a great consolidation, under unified control, a condition that will force Canadian steel interests to fall into line with the general tendency of the times towards self-protection by a combination of forces.

MINING SOCIETY OF NOVA SCOTIA.

Proposal to Change Name of Society and Date of Annual Meeting.

At the Annual Meeting of the Mining Society of Nova Scotia, which will be held in Glace Bay, Cape Breton, on the 4th and 5th of May, a motion will be made to change the name of the Society to "The Nova Scotia Mining and Metallurgical Society." A further motion will be made to allow the Annual Meeting to be held between January 1st and July 1st in each year, instead of between January 1st and April 1st, as prescribed in the by-laws.

C. N. R. CONTRACTS TOTAL $25,000,000.

Contracts for New Equipment Awarded to Following Canadian Firms.

Contracts for equipment to the approximate value of $25,000,000 have been placed by the executive of the Canadian National Railways as follows:

Canadian Locomotive Company, Kingston, 45 locomotives.

Montreal Locomotive Works, 67 locomotives.

Canadian Car and Foundry, Montreal, 18 sleeping cars, 12 dining cars, 20 baggage cars, 1000 box cars, 600 refrigerator cars, 80 cabooses.

Eastern Car Company, Trenton, N. S., 500 box cars, 1,150 coal cars, six snow plows.

National Steel Car Company, Hamilton, 1,500 box cars.

Preston Car and Coach Company, Preston, 20 cabooses.

Hart Otis Car Company, Montreal, 250 ballast cars.

The Sinking of Wabana No. 3 Slopes, Newfoundland

By R. E. CHAMBERS.*

During the year 1919, there was completed at Wabana, Newfoundland, a pair of slopes, the construction of which means much to the steel industry of Nova Scotia, as it assures to the Nova Scotia Steel and Coal Company a permanent supply of iron ore of enormous extent. This ore had been previously opened up by slopes, driven for a distance of 4,000 feet through the sub-marine ore of the Dominion Company into the areas of the Scotia Company, and for a further distance of 3,000 feet into the Scotia areas, these being termed the No. 2 slopes. But according to the agreement made between the two Companies the No. 2 slopes were to be surrendered at the close of the year 1918, and the ore from the Scotia submarine areas was to be mined through a new set of slopes to be completed by that time. Although a very formidable undertaking extending over several years, these slopes were completed at the time specified and are now producing 1200 tons of ore per day.

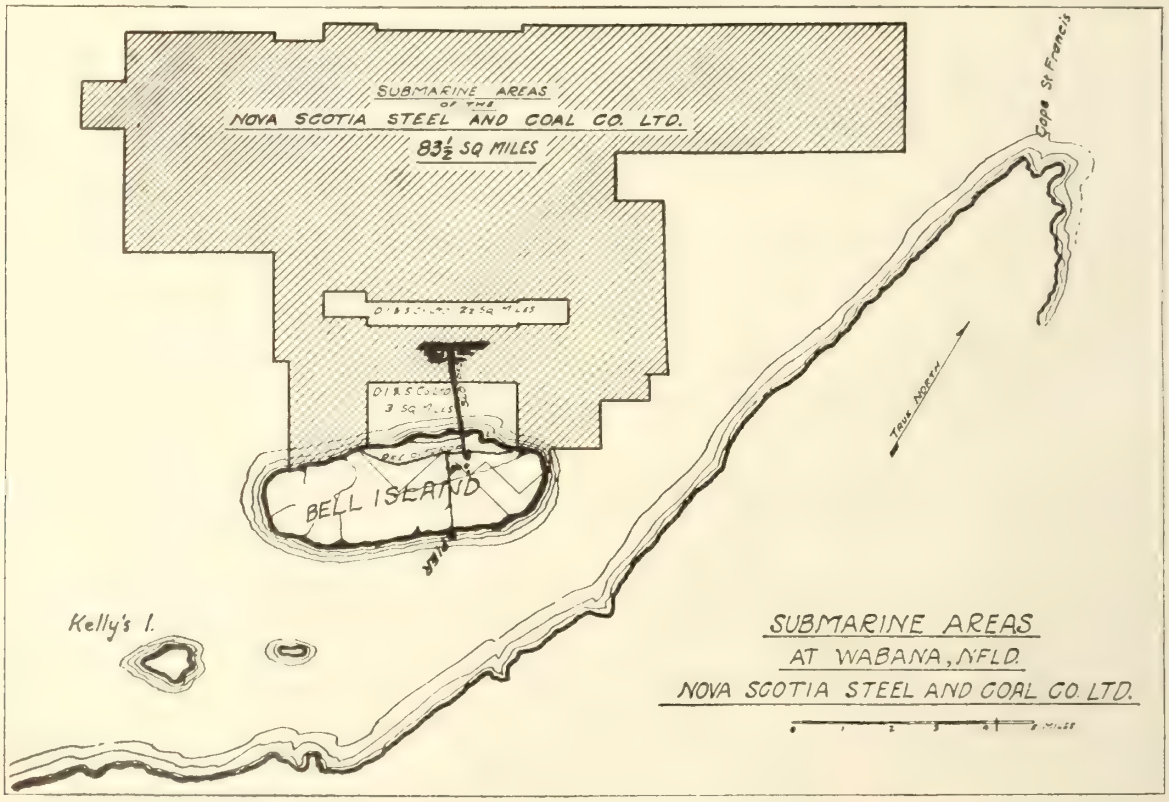
The construction of the No. 2 slopes was described in an article published in Vol. 12 of the Journal of the Canadian Mining Institute. It is to the second set now known as the No. 3 slopes of the Nova Scotia Steel and Coal Company, that the present reference is made

* Mining Engineer and Director of the Nova Scotia Steel and Coal Co., New Glasgow.

Briefly, the work consisted in driving two parallel slopes, each two miles long, and each with a cross section of 10 ft. by 17 feet at an average grade of about 13 per cent from the main level of the Scotia submarine mine to the surface near the outcrop of the lower bed of ore. The total time occupied was not phenomenally short being about 5 years. The work was, however, much delayed during the period of the war by shortage of labor and other drawbacks, being for certain periods entirely discontinued.

The speed of driving for certain monthly periods, while labor was plentiful, was more creditable. The average advance over monthly periods was over 12 feet per day in the West slope and over 11 feet per day in the East slope. While for level tunnels this is not a record, yet when the large dimensions of the slopes, the descending grade of 13 per cent, the handling of a considerable quantity of water, a somewhat faulted ground and other adverse condiions, are taken into consideration, the speed above referred to is rather exceptional. It is not, however, with the object of claiming any record, that this is written. But having been asked for a description of the work, there are two principal reasons which appear sufficient for endeavoring to comply.

First:—To emphasize the fact that the completion of these slopes assures to the Nova Scotia Steel and Coal



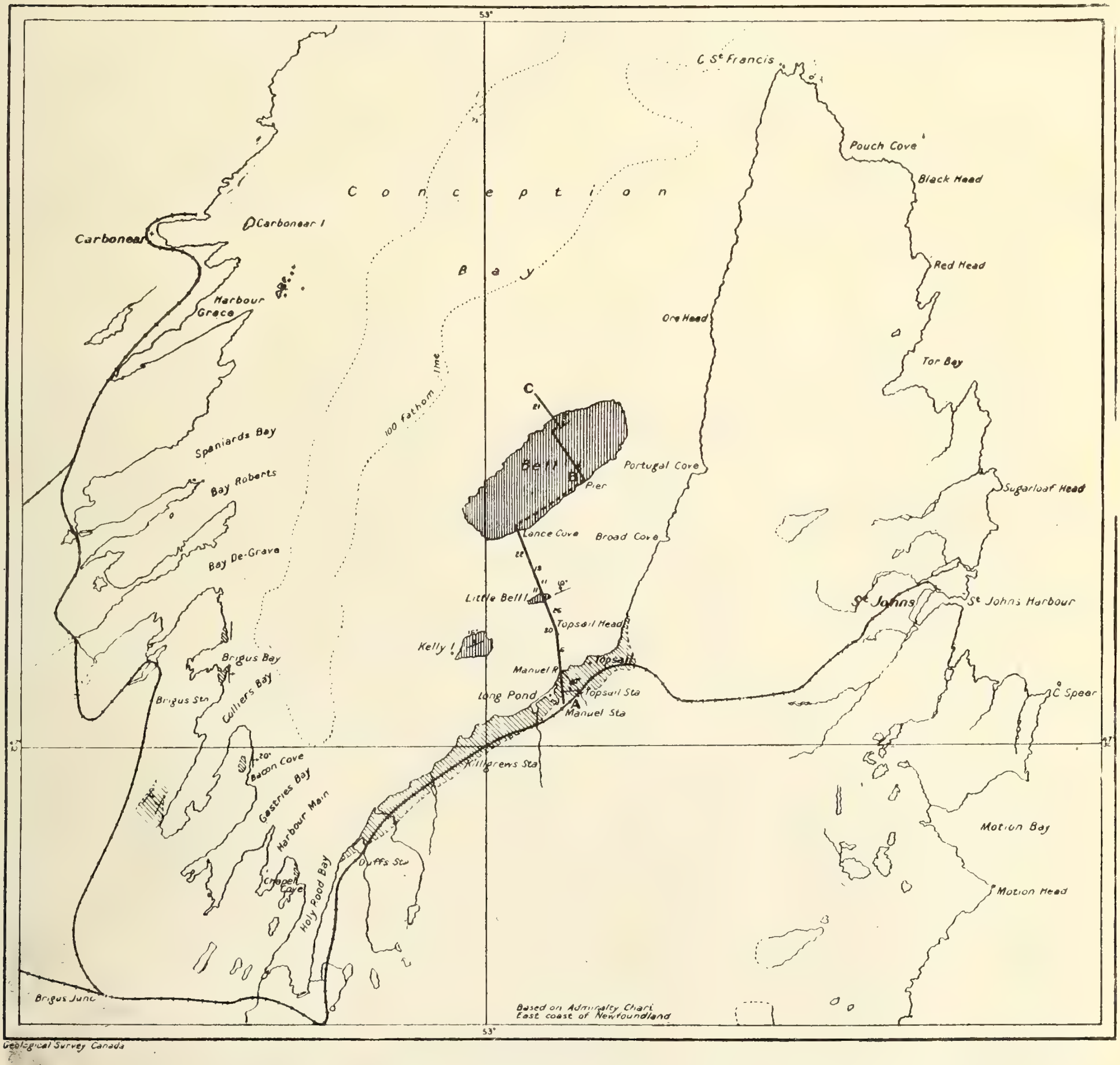
General Plan of Submarine Areas of Iron-ore at Wabana, Nfld., showing approximate position of slopes and workings.

Company an ample supply of ore for the future. The ore has been found to extend to the farthest working yet reached. These workings are two miles to the dip from the outcrop of the bed, and the slopes are among the longest known, yet the ore extends below their deepest point. During the past 24 years the blast furnaces of the Scotia and Dominion Companies on Sydney Harbour have been supplied and several millions of tons exported in addition, from an area of about two square miles of the ore field.

The submarine holdings of the Scotia Company cover an area of about 83 square miles, and of the Dominion Company 5½ square miles. The same geological conditions are believed to extend over the greater part of these areas. The Scotia slopes are now working at a capacity of 1200 tons per day; with improved labor conditions this can be much increased. While the ore beds vary in thickness over different parts of the field, the thickest section known is in the submarine mine of the Scotia Company two miles from the outcrop. Attempts to reduce to exact figures the ore tonnage of this field are necessarily connected with uncertainty, but it is evident that in the enormous area of the Scotia Company, above referred to, there is an ample supply for all their future requirements. The geological conditions peculiar to the ore field are believed to extend to the dip a much greater additional distance than the slopes are now driven, and the evidences indicate that on the strike the ore will extend for many miles, placing the Scotia Company in a most favorable position for ore.

This result has not been obtained without much effort in many fields.

In many, we may say most cases, such investigation has been unproductive, but in the case of the Wabana deposit and some others which warrant future consideration, the result has fully justified the energy and the somewhat large sums of money expected in ex-



Position of Bell Island with reference to Mainland.—White Areas are Pre-Cambrian, Perpendicular Hatching denotes Ordovician, and Cross Hatching denotes Cambrian rocks.

ploration, development work and equipment. The Scotia Company is now in the happy position of being independent as to the future ore supply for themselves, and if required, for others, and in the opinion of all mining experts who have studied the question, of owning one of the largest iron ore mines on the North American Continent and its outliers.

Second: The successful construction of these slopes, apart from the element of luck, which continued most favorable, was largely due to the faithful and energetic efforts of the mining staff under me during the period in question, and I wish to give some public recognition of this service. During the several years in question the work was followed with undiminished energy and intelligence by the various heads of departments and the staff generally. It is not practicable to give a full list of those to whom credit is due. This would include the members of the office, mechanical and surveying staffs and many of the workmen, but I would like to mention the following names, and hope others taking a less prominent part, but who performed their duties faithfully, will pardon the omission and understand that with 200 men engaged in the work, it is not practicable to publish all.

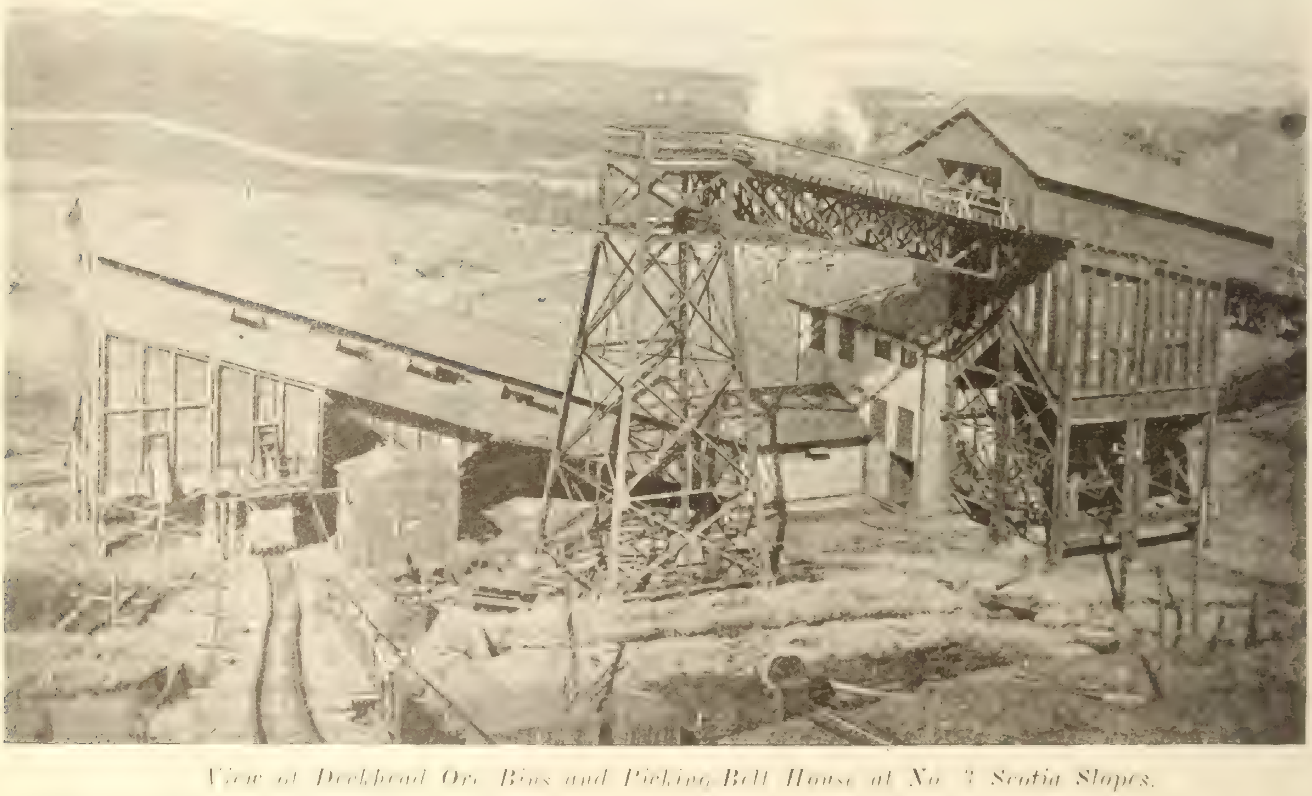
Staff Connected with No. 3 Wabana Slopes.

1. A. R. Chambers, in general charge.*
2. C. B. Archibald, in charge locally.
3. F. Burrows, late resident manager
4. L. McLean, underground manager.
5. T. Gray, Asst. Underground Manager.
6. C. Main, Mechanical Superintendent.
7. R G. Watson, Mechanical Superintendent.
8. Wm. Lindsay, Mechanical Department.
9. Wm. McGrath, Mechanical Department.
10. Thos. Blackwood, Sinking Foreman.
11. M. J. Murphy, Sinking Foreman.
12. J. B. Gilliatt, Chief Surveyor.
13. John Harvey, Heading Boss.
14. John Gunn, Heading Boss.
15. Fred Droken, Heading Boss
16. Fred Noftall, Heading Boss
17. Reid Proudfoot, Accountant.

The number identifies the persons shown on the accompanying photographs.

The improved efficiency in driving these slopes in comparison with other similar work previously done is attributal to two principal causes, viz.:

A system of tramming was adopted, by which the muck at the face was more quickly disposed of after blasting. The crosscuts, which were located at about 1200 feet intervals, were driven at an angle of about 30 degrees with the centre line or slopes instead of at right angles, as in the previous slopes. This enabled a hoisting engine of large capacity stationed at the surface deckhead to tram from both the East and West Slopes with very little delay of trips. Smaller electric engines did the tramming at the immediate faces, and assembled the trips for the longer hoist to the deck. By fans of ample capacity connected to 18-inch spiral rivetted pipe extending below the last crosscut driven, an ample volume of air was supplied to the working faces, enabling work to be resumed at a comparatively short time after blasting, and helped to maintain the energy and efficiency of the workmen.



View of Deckhead Ore Bins and Picking Belt House at No. 3 Scotia Slopes.

Bonus System of Payment to Workmen.

Another factor, which contributed largely to increased efficiency was a well adjusted bonus system. All foremen and laborers underground received an advance in their wages varying up to 75 per cent, according to the advance made per week. This bonus system was largely responsible for the continued interest and effort on the part of all concerned, and contributed much to the successful completion of the work. There being a time limit, it was necessary to excavate from both ends, necessitating very careful surveying to ensure the proper connections. In the final break-through the error was found to be so small as to be inappreciable.

Rate of Progress.

The cross section of the slopes is 10′ x 15′ inside timbers, which necessitated about 11′ x 17′ of excavation. The total length driven in the West Slope is 11,233 ft. and in the East Slope 10,755 ft. The best week's work in the West Slope was 83 feet for the week ending April 15th, 1918 and in the East Slope 81 feet for the week ending April 8th, 1917.

The best months advance for the West Heading was 344 feet in April, 1917, and for the East Heading 285 feet in, October, 1916.

The total excavation for both slopes was 127,613 cu. yds. with an overbreak of 11,315 yards or 8.8 per cent.

Power Plant.

A most important factor in work of this description is a careful preliminary study of the plant required and it is false economy to endeavor to save on this item. Fortunately in this case, the Mine having been in operation for many years with a large accumulation of various machines, the purchase of such new material was not necessary, but even in cases where new purchases are necessary, machines of ample capacity should be secured for drilling, hoisting, pumping and ventilation.

The followng is a brief resume of the plant required and used for this work and for help in the preparation of which acknowledgment is made of the assistance of the officials at the Mine.

The regular mining plant supplied the requirements for Boilers, Electric Power, Compressors and some other items, and it being impossible to separate the two services the whole plant is referred to in the lists of those three services.

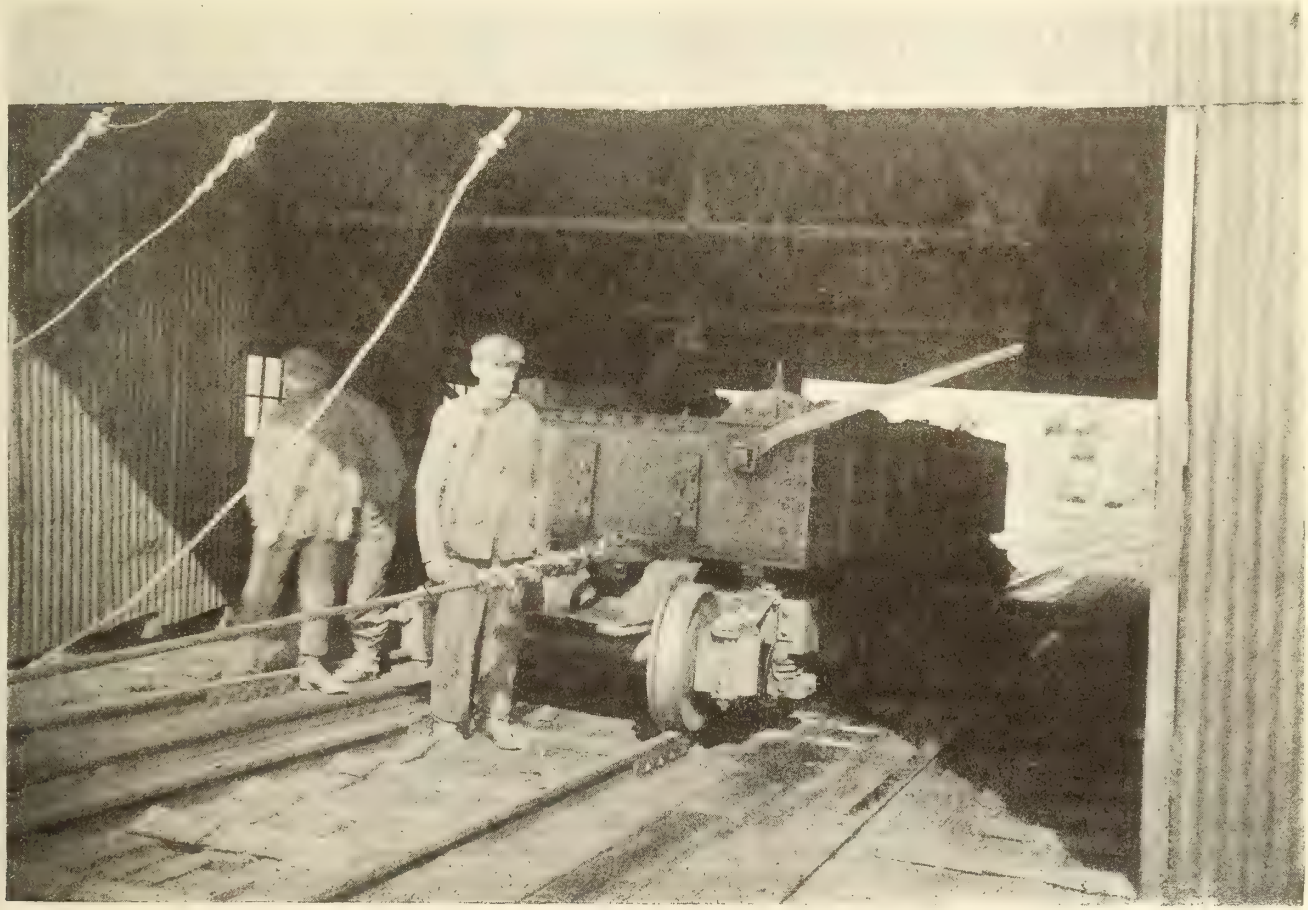
Boilers.

Steam was obtained from boilers of the general mining plant consisting in part of 3 batteries (6 boilers) Sterling water-tube boilers, 231 h.p. each, 1 boiler 200 lbs. pressure 100 degrees superheat with chaingrate stokers.

At the central air-plant, 1 batttery (2 boilers) same dimensions hand fired, and 1 battery (2 boilers) at the old submarine or No. 2 Slopes.

Electric Plant.

Electric power also from the general mining plant consisted of 2 Brown-Boveri, 3 phase, 60 cycle, 500 K. W. generators, 6,800 volts, driven by Belliss & Morcom triple expansion condensing engines.



Main Slope Ore-Car. Makes the trip of two miles in five minutes with 20 tons of ore.

View of Break-through of the Slopes. This took place in No. 3 West, at 7,500 ft. down from the surface, or two-thirds of distance.

Another View of Deckhead, etc., at No. 3 Slopes

Air Compressors.

1 Walker duplex Cross Compound 3,500 cubic feet per minute capacity.

1 Nordberg duplex cross-compound of 2,700 cu. ft. per minute capacity.

1 Reavell electric Single-Stage, 4 cylinder of 500 cu. ft. per minute capacity.

1 Sulivan electric of 625 cu. ft. per minute capacity.

Hoisting Engines.

In the early stages of sinking a Lidgerwood 10 x 12 steam hoist converted to an electric with 52 H.P. Westinghouse motor at the West Slope and one of similar capacity at the East Slope were sufficient. As the face advanced however, it was necessary to install a 112 H.P. single-drum Lidgerwood at the West Slope freeing the one previously in use, for handling the rock to the waste dump on the surface.

Subsequently a 50 H.P. electric hoist was set up near each face for handling and assembling the trips. Still greater depth necessitated an electric hoist with 2-112 H.P. motors at the surface and before the completion of the slopes it was necessary to still further supplement this by stage hoisting with an additional engine of the same type installed at No. 4 Crosscut.

Ventilation Plant.

Very careful preliminary study was given to this as a result of which a 48″ Sturtevant fan was installed at the air shaft to produce a circulation of 15,000 cu. ft. of air through the Slopes and lowest crosscut; the upper crosscut being of course, built off as the lower was connected.

In driving below the lowest crosscut by installing between each face and the lowest crosscut a 20 H.P. electric fan of 5,000 feet capacity each, connected by spiral rivetted pipe of 15 inch and 18 inch diameter, it was found possible to advance the faces 1,200 feet beyond each crosscut before driving the following one. Pressure fans were used because the heavy current of air blowing from the end of the ventilation pipe was found to sweep the working face and clean the atmosphere much more quickly than the exhaust method.

This installation enabled the dynamite smoke to be cleared from the faces promptly after blasting, permitting work to be resumed with a minimum of delay.

Drills.

At the start the U. D. Sullivan piston drill was sufficient. As the work advanced however and some quartzite bands of extreme hardness were encountered, it was necessary to change to the D. R. 6 water-tube bit, self-rotating hammer drills. These latter proved eminently satisfactory and while somewhat expensive in maintenance were a very important factor in the successful completion of the work.

Pumps and Pipes.

Although it was expected that much water might be encountered in these slopes, this was fortunately not realized, the quantity being considerable but not excessive. In anticipation of contingencies however, a pretty complete installation of pumps was made and without going into particulars of their location, etc., they consisted of the following:

4 No. 6 Cameron Pumps.

1 18 x 18 x 29 Jeansville Pump.

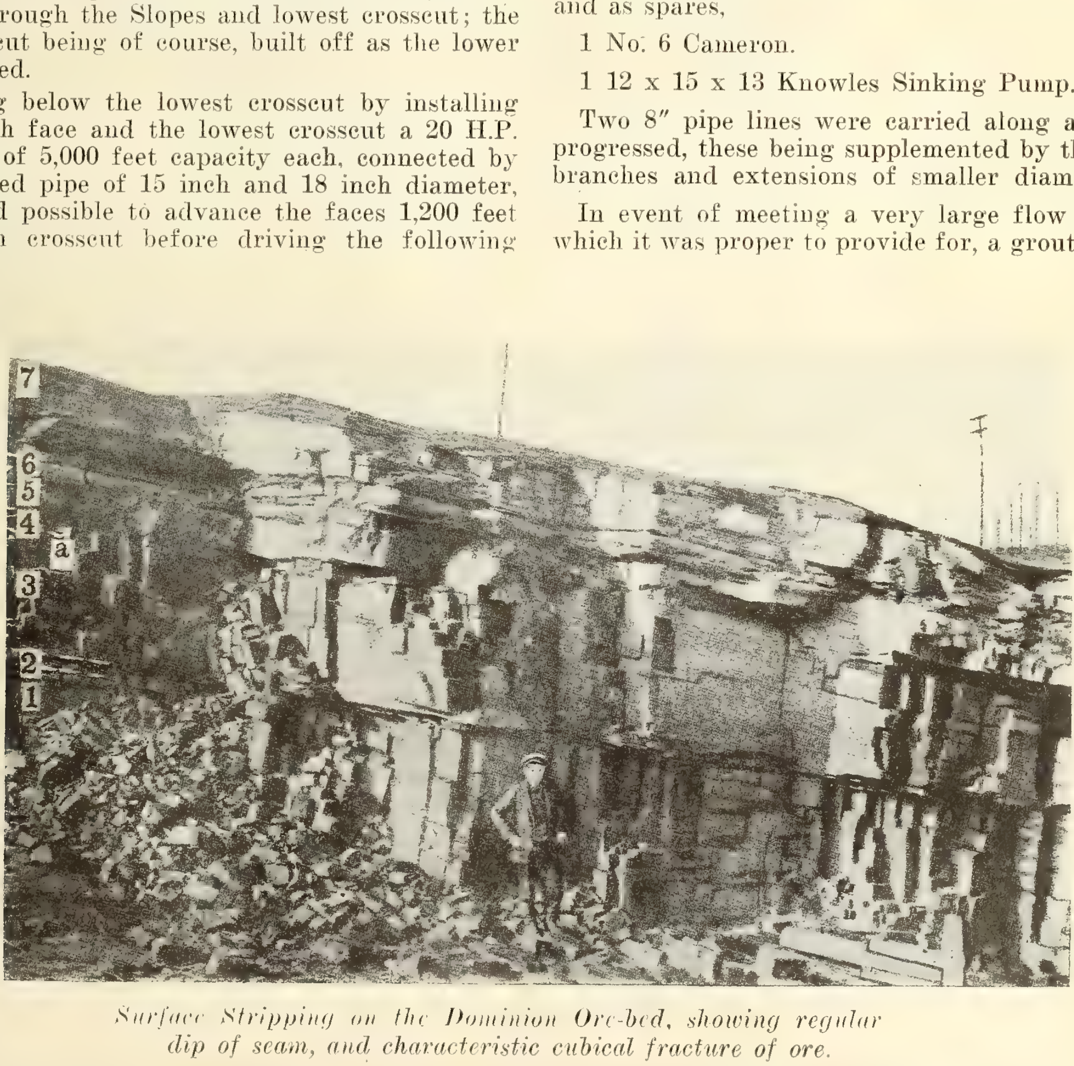
2 10 H.P. 2 Stage Allis Chalmers Centrifugal Pumps.
and as spares,

1 No. 6 Cameron.

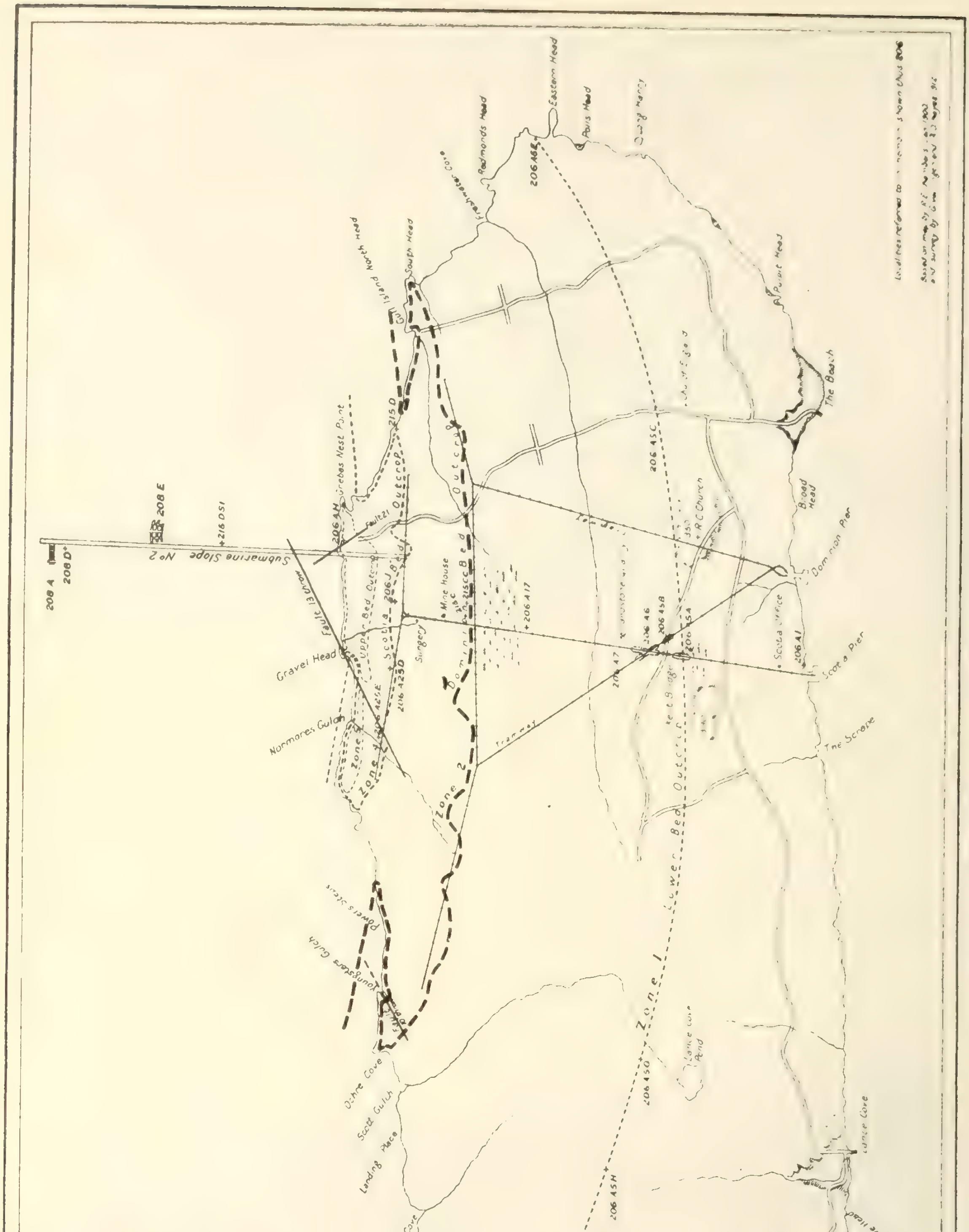
1 12 x 15 x 13 Knowles Sinking Pump.

Two 8″ pipe lines were carried along as the slopes progressed, these being supplemented by the necessary branches and extensions of smaller diameter.

In event of meeting a very large flow of water, which it was proper to provide for, a grouting machine



Surface Stripping on the Dominion Ore-bed, showing regular dip of seam, and characteristic cubical fracture of ore.



Outcrops of Ore-Beds on Bell Island.

capable of injecting cement grout against a pressure of 600 lbs. per square inch was constructed, and kept ready for emergency near the work. This machine was similar to those used in the New York underground tunnels of New York city and was under the supervision of a specialist in this line from there, who spent some time at Wabana.

Tramming.

Perhaps of first importance in any work of this kind is an efficient system of tramming.

Cars of 30 cubic feet capacity running on 30 lb. rails with track of 3 ft. gauge in trips of 5 or 6 cars handled by the capacious engines above referred to, resulted in prompt removal of the muck after each blast and did the work under this heading in a satisfactory manner.

Protection from Runaway Cars.

Sampson Posts and other swinging gates were installed above the working faces for the protection of the miners at the face, and also a trailer used behind each trip. The gates and posts were promptly moved ahead as the face advanced, the result being a comparative freedom from accidents from this cause.

Surveys.

In a recent issue of the Canadian Mining Journal, James Purves, described a very creditable survey of slopes constructed at Princess Colliery, Sydney Mines, very similar to those under discussion.* The length of both was about two miles, but the angle of inclination 5 per cent at Princess and 13 per cent at Wabana. The principal difficulty encountered at Princess was from unstable or shifting ground, the conditions being not quite as bad as near the Pitch Lake in Trinidad where a line of stakes run straight at night is a series of curves the next morning, but having the same difficulties in a lesser degree. This difficulty made the result achieved by Mr. Purves very creditable.

The ground was firm enough at Wabana but probably the distance of carrying the survey rather greater, being at the time of the connection of headings, on account of the slopes being driven from both ends about four miles. The surface or descending end of the slopes were started on the produced centre line of the old No. 2 Slopes, a base line was then established and its alignment produced over the surface and down No. 2 West Slope to the main level in the submarine workings. A traverse by way of the levels and submarine workings and a slant excavated for the purpose to a point on the desired centre line, about 9,000 ft. from the surface, from which point angles were turned to the proper course, and the uphill driving commenced resulted successfully.

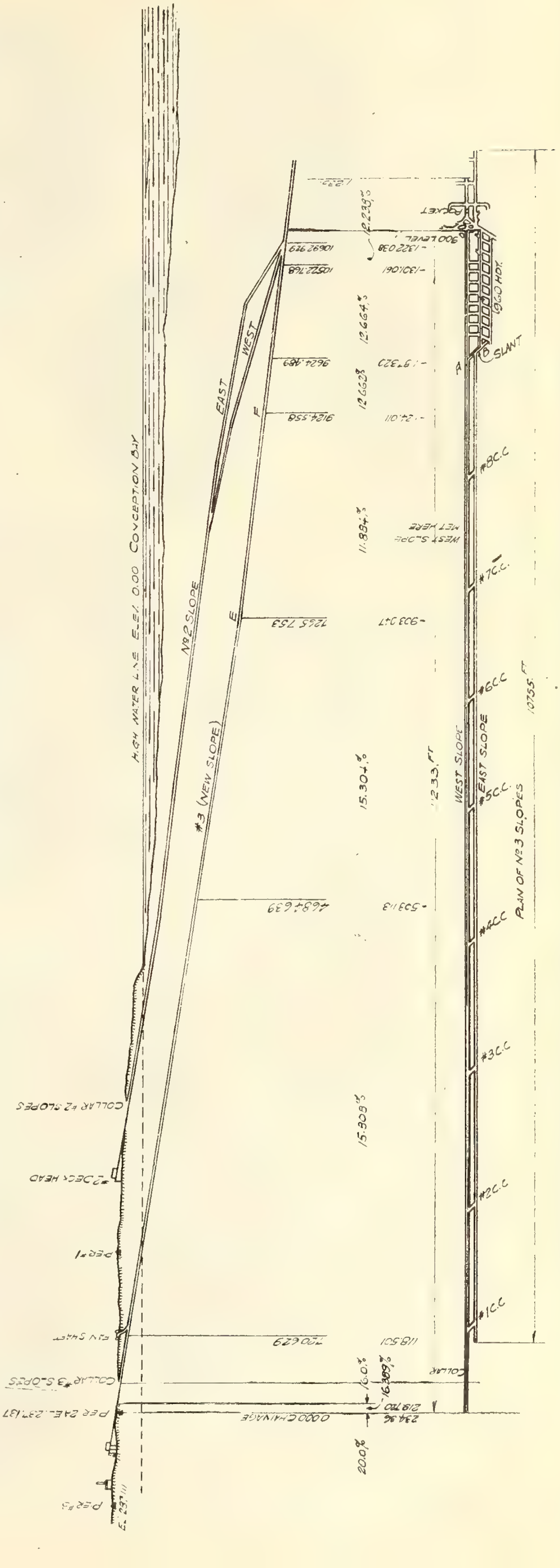
Grades and alignment were carried by plugs driven into holes in the solid roof. After about five years of excavation, the downhill and uphill headings finally met with the following result.

Error in alignment, ... 0.10 feet

Error in elevation, ... 0.217 feet

Error in chainage, ... 0.062 feet

* See Canadian Mining Journal, p. 804, 1919.



Plan and Section of the No. 3 Slopes.—Nova Scotia Steel & Coal Co., Wabana, Newfoundland.

Members of Staff connected with Sinking of No. 3 Slopes.
See page 56 for index to names.

The greater error of elevation over alignment was to be expected from the necessarily short sights in a slope of 13 per cent inclination.

Method of Working.

The length of shifts was 10 hours commencing at 7 a. m. and 7 p. m.

Blasting was done in the intervening hours between shifts.

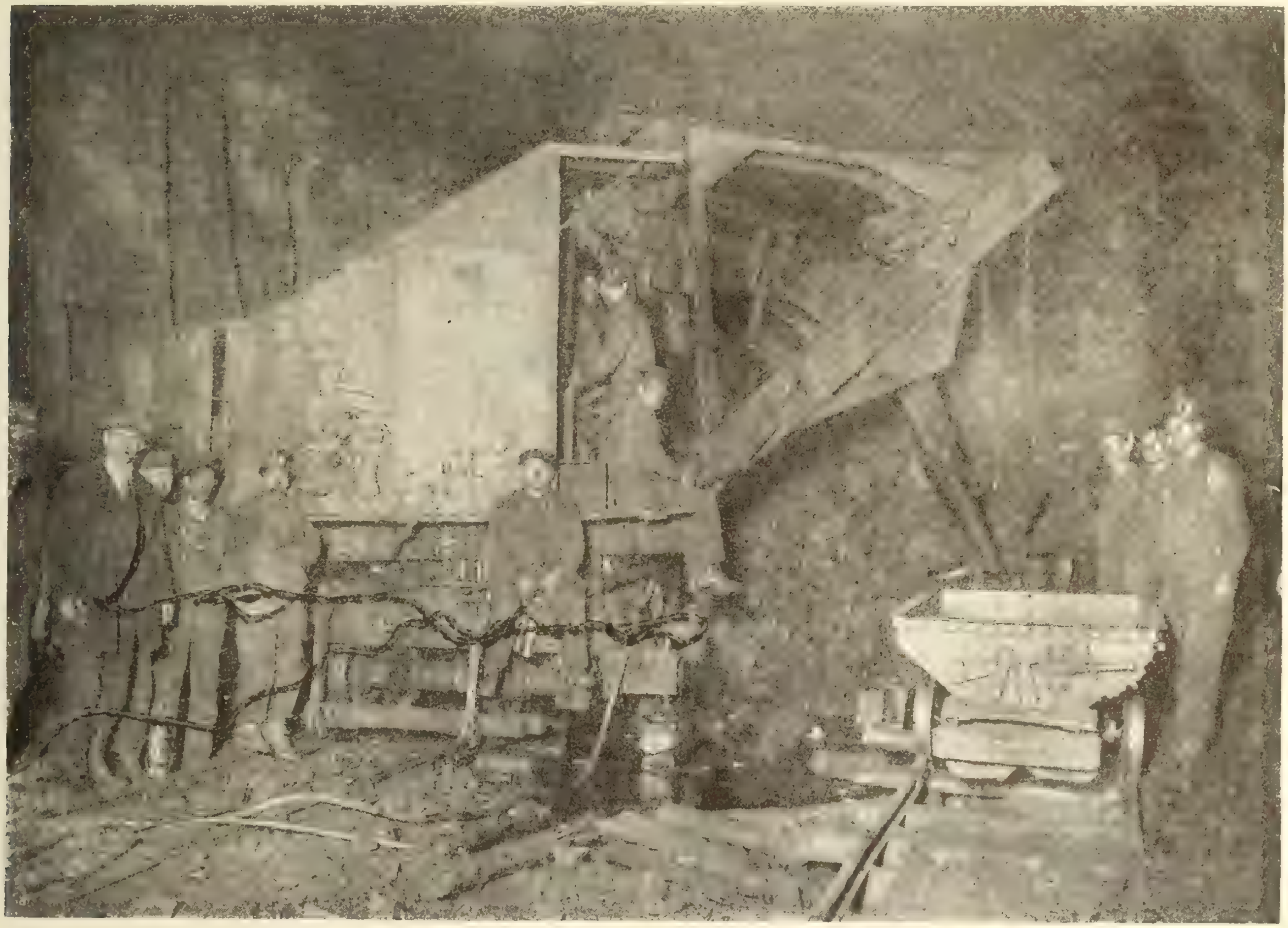
The method of drilling and blasting was similar to that employed in driving No. 2 Slopes, which was described in Volume 12, of the Journal of the Canadian Mining Institute.

The shifts were commenced by the preparatory work of cleaning back the muck from the face and connecting up air and water lines. This accomplished the routine work of drilling, mucking and timbering as far forward as practicable without interfering with the work at the face, was rushed till the accumulated pile from the previous blast was sent to the surface.

The blasters now took charge as soon as the shift men were hoisted to the surface. After blasting and a reasonable time allowed for the smoke to clear away, the face was examined for missholes, loose rock taken down by the face cleaners, and after the place being reported safe, the same routine followed by the succeeding shift.

The regular timbering was kept advanced as near to the working face as possible, which in practice was found to be 60 or 70 feet. Where required temporary timbers were put in in this intervening distance, but usually the roof was firm enough to stand up till the regular timbering force working behind the excavation made it secure.

The very effective type of haulage successfully used for the first time in these slopes is of special importance to the steel industry of Cape Breton inasmuch as it points to a solution of the haulage problems arising from the moving of submarine deposits of coal at increasing distances as the working faces recede from the shore.



Thew Electric Shovel, Loading Iron-ore into Mine-car in the Scotia No. 3 Mine at Wabana, Newfoundland.

Synthetic Cast Iron

By CHARLES ALBERT KELLER (Livet, France).

Part 1.—Synthetic Cast Iron, its Origin and Development.

"Synthetic cast iron" is the term by which, since the commencement of its manufacture in the electric furnace, the author has always described the iron obtained by the recarburising melting of steel turnings. This term has since passed into metallurgical currency, and has now become generic.

The novelty of the manufacture of "synthetic cast iron" consists in carburising iron and steel scrap, and more particularly turning by melting these materials in the presence of carbon which is introduced simultaneously with them in the melting appliance. The electric furnace is plainly indicated as best fulfilling all the conditions required for the carrying out of this metallurgical operation.

From the outset of the manufacture of steel in the electric furnace there had been obtained, incidentally and without any practical importance being attached to it, the carburisiation of steel to cast iron composition. Apart from this, and indeed long before it, the process of carburising iron up to saturation point was well known. No advantage was, however, derived from these facts, as the carburisiation of a bath of steel in a covered-in furnace, obtained by the various known methods of carburisation, such as the introduction of dense conglomerates of carbon and iron (carburite) or pressed blocks of carbon and cast iron was only practised with the object of obtaining steel and, moreover, these processes are neither convenient, practicable, nor economical when carburisation is carried to the extent of producing cast iron. Only a process of continuous carburisation, effected during the course of melting a mixture of steel turnings and carbon,[1] could conduce to an economic method of producing synthetic cast iron with a commercial future capable of development as other than a mere war emergency.

The preliminary melting of steel turnings in a bricked-in furnace necessitates indeed, the consumption of an amount of energy corresponding with the temperature which has to be developed in order to melt the steel. It must further be remembered that the thermal efficiency of a furnace of this type is lower than that of an open type furnace constantly replenished with materials for melting, and the walls of which are much cooler. On the other hand, charging turnings into a closed-in furnace, with doors, involves technical difficulties. These disadvantages are, however, but small in comparison with those accompanying the actual carrying out of the carburisation in the two instances. The carburisation of turnings, after melting, can only be effected by solution brought about between the upper layers of the metal and the carburants. It becomes the more difficult, and the slower, the higher the percentage of carbon rises. The dense carburants employed are expensive, and the consumption of energy resulting from the slowness of the carburisation becomes considerable. As the furnace has to be emptied after each heat there must likewise be taken into consideration the heat losses inseparable from this operation, as well as the repairing of the hearth, sides and roof, none of which arise in the continuous running of an open furnace.

In an electric furnace charged with steel turnings mixed with carbon the carburisation is not only absolutely controlled by the known reactions of the substances present but, it should be noted, as an important economic advantage, that the combination of the carbon with the iron begins in the upper parts of the charge, long before actual fusion. Cementation intervenes from a temperature of 650° upwards and becomes more rapid in proportion as the temperature rises, owing to the descent of the charge.

Carburisation of the iron takes place subsequently by the contact between the solid carbon and the partially carburised metal in the course of melting, and becomes complete on full melting, the temperature of which is determined by the nature of the iron, so that casts can readily be obtained in the electric furnace at temperatures of 1200° to 1300° C.

The author has so far dealt only with the carburisation properly so called. The proper working of the process in the electric furnace involves, however, other considerations. The mixture of steel turnings and carbon possessing, in itself, very high conductivity, it would become necessary, to ensure normal working in the electric furnace, to use so low a potential that higher currents than those ordinarily in use could be employed. On the other hand it would be a pity to employ electric fusion without profiting by the metallurgical advantages involved, in order to effect desulphurisation. The introduction of basic slag into the charge meets these two requirements and accomplishes two results, subsidiary and supplementary to the carburisation and necessary to the complete practical success of the process, namely:

(1) The lowering of the conductivity of the mass to be treated by the introduction of a non-conducting material amongst the conductive materials (turnings and carbon), thus enabling fusion to take place under ordinary thermo-electric conditions, and

(2) Complete and easy desulphurisation of the resulting metal.

Thus carried out, the process may be described, from the metallurgical point of view, in the following terms:—

The iron obtained in the presence of a sufficiently basic slag, which combines with the small amount of silica introduced, will contain practically all the substances contained in the charge, except the sulphur. There will be no increase in the silicon, and the carbon in the charge will be used up solely in carburisation, without any appreciable intervention of the silica.

White cast iron can thus easily be obtained with ordinary steel turnings. With turnings containing 0.44 per cent. of silicon, 0.55 per cent. of manganese, and 0.07 per cent. of sulphur a white iron of the following composition was obtained:

*Note. A paper read before the Iron and Steel Institute, England.

	Per Cent.
Carbon	3.55
Silicon	0.52
Manganese	0.48
Sulphur	traces

Hence control of the percentages of silicon and of other elements becomes easy; for example, extra silicon will result from introducing more silica into the charge, along with a corresponding amount of carbon for reducing it. The percentage of silica in the slag will vary according to the percentage of silicon in the iron.

The certainty with which the above considerations can be relied upon allows of the process of manufacture described by the author being regarded as complying absolutely with the predetermined calculation of the charge, and as corresponding absolutely with the estimated amount of the elements contained in it. He can afford a proof of the truth of this conclusion by adducing an instance of an electric furnace with a capacity of 80 to 100 tons per 24 hours, which has not given rise, over a month's working and while specially watched for that purpose, to variations exceeding 0.25 in the results of carburisation and of siliconisation respectively.

It will have been thoroughly understood from what has been said that control of the composition of the slag must be strictly exercised; also that the amount of carbon introduced must be accurately known. The process being one of great accuracy, is correspondingly highly sensitive. It is necessary, therefore, to rely entirely on the help of the chemical laboratory.[1]

The carbon employed for carburising should correspond so far as its physical condition is concerned, with the size of the steel turnings, so that the contact between the particles may be as perfect as possible, and so as to faciliate carburisation in the higher portions of the furnace charge. Small coke is highly suitable and so is wood charcoal. Either may be used according to price and to the degree of purity sought.

The system that has been described is one of extreme simplicity. It does not require any skilled workman as the results sought are independent of any technical manipulation except in so far as the preparation of the charge is concerned, and depend entirely on an accurate knowledge of the composition of all the components.

The electric furnace, fed continuously by the charge, works regularly with very small losses as the heat transmitted by the electric hearth situated immediately beneath the charge is, to a very large extent, utilised in heating up the materials, and effects a preliminary carburisaation prior to melting. This enables the consumption of electric energy to be reduced to as little as 675 kilowatt-hours per ton of pig in a 2500 kilowatt furnace of 80 to 100 tons. Maintenance of a furnace, working in the manner described, is barely appreciable, seeing that with a six months' campaign at Livet the above furnace did not require any repairs either to linings, shell, or any other part. The lining only needed some attention when the furnace was put out of action owing to the water power supply failing.

The author feels it unnecessary too minutely to emphasise the advantages arising from the profound difference that exists between obtaining casting metal by the slow carburisation of previously melted metal by contact beween carbon and the bath (solution of carbon in liquid steel), and obtaining casting metal by contact between carbon and the bath (solution of contact at a high temperature between solid or pasty metal and solid carbon. They are determining factors both from the standpoint of economics and of metallurgy. The fundamental economic considerations in the manufacture of synthetic pig are as follows:

1. The electrode consumption can be lowered to as little as 6 kilogrammes per ton, with electrodes of good quality.

2. The consumption of unoxidised turnings is 1050 kilogrammes per ton of iron, a figure which, even with moderately rusty scrap, becomes only a little over 1100 kilogrammes.

3. The amount of coke with 80 per cent. fixed carbon required to produce a ton of strong pig iron with 3 per cent. of carbon and 1.75 per cent. of silicon, starting with normal turnings of shell steel, is about 80 kilogrammes.

4. A furnace of the 80 to 100 ton type should be provided with mechanical appliances for upkeep and charging, so that its operation does not require more than fifteen workmen, for the preparation, by hand, of the charge, for charging, and for regulating the furnace.

5. Tapping, and loading up on trucks as required needs seven men per unit, and handling in the stockyard another two men.

The general economy of the process, combined with the simplicity of the method of carrying it out, leads the author to believe that while synthetic iron found a very wide field of application during the war, owing to the very large production of steel turnings derived more particularly from shell manufacture, it will find no less a field after the war in, for example, producing those steel-like qualities of material required for highly resistant mechanical parts.

The most obvious plan to adopt is to lay down a foundry for such parts adjacent to the synthetic cast iron plant, as has been done at Livet. In such a case the foundry iron from the primary furnace may, if preferred, be made use of by transferring it to an electric mixer which can mix several casts and thus keep any quantity of metal ready for castings. This mixer, of the steel furnace type, allows of the quality being ascertained by samples being taken before casting. It is needless to dwell at any further length on the method in question.

The manufacture of malleable cast iron is likewise easily accomplished in the electric furnace, as the general quality of the steel turnings enables the low percentage of silicon and manganese required to be readily obtained, the reduced percentage of carbon present being dependent on the composition of the charge. It will also be seen that synthetic cast iron may find a further field of application in the manufacture of special pig, by means of special additions, such, for example, as nickel, chromium, &c. In such cases benefit will be derived, in making this kind of iron, from the absence of hydrogen, nitrogen, carbonic oxides and occluded air.

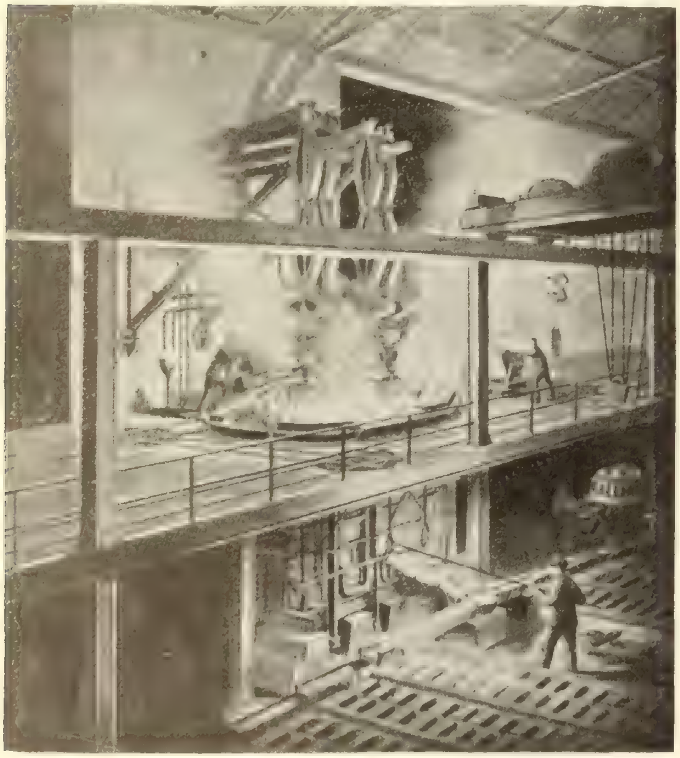
So much, therefore, for the cast iron obtained under desulphurising conditions.

The materials required for National Defence were generally confined to cast irons whose purity, in regard to phosphorus, corresponded practically with that of the steels used in the production of synthetic

cast iron, seeing the sources whence these steels were derived. After the war the situation will be altered. Steel turnings will come from a variety of sources, and will no longer be under the same guarantees, so that very often it will be their dephosphorisation which will be of chief importance when a cast iron of high quality is required.

The metallurgical value of the results obtained by the process alter completely when it becomes a question of dephosphorisation, which the author has practically accomplished by means of a dual process.

In the first place the steel turnings are melted in the presence of a small quantity of carbon and of a basic oxidising slag. It is necessary to aim at a critical carburisation which must be as high as possible, in order to lower the temperature of working and to facilitate the casting of the metal while at the same time effecting dephosphorisation. A percentage of 1 or slightly over realises this object.



2500 Kilowatt Keller Electric 80 to 100 ton Furnace.

This first-stage dephosphorised metal, containing low percentages of silicon and manganese, is, according to circumstances, either cast into small ingots which are subsequently melted in an open furnace mixed with the necessary additions of carbon and a desulphurising slag composed of materials containing exceedingly little phosphorus, or else poured into a second furnace of the bricked-in type and covered with a layer of anthracite for recarburising. The synthetic cast iron produced is controlled in respect of its silicon and manganese percentages by the addition of oxides and of a corresponding amount of reducing carbon, in the ordinary way. This mode of working somewhat increases the cost of production during the first phase, and further necessitates, in the second phase, a converting-cost equivalent to that of manufacturing ordinary synthetic cast iron. About 1500 kilowatt-hours must be allowed for the two operations.

The higher costs of manufacture are balanced by the higher value conferred on the synthetic cast iron by reason of its extreme purity in regard to phosphorus, and likewise its purity from sulphur and its uniform composition in respect of silicon and manganese. From the commercial point of view such material can compete with Swedish iron.

The author will conclude this account of the chief metallurgical results obtained with synthetic cast iron by describing an alternative process which has been led to contemplate in connection with the manufacture of steel from steel turnings.

As in the preceding example, the steel turnings are melted in an open furnace fed by the charge, but the slag, instead of being oxidising, is desulphurising, and the quantity of carbon introduced with the charge should be sufficient to reduce the oxides in the turnings and to carburise the metal to an extent distinctly above the percentage of carbon sought in

The Vernes Fall Power Works at Livet.

the steel, so as to facilitate the pouring of the desulphurised metal and to allow of an oxidising working in the second stage of the operation.

For example, if a steel with 0.5 per cent. of carbon be required, the metal in the primary furnace may be poured at 1.5 per cent. of carbon. It will, as has been said, have been freed from sulphur during melting.

The secondary operation, which can be either in an open-hearth furnace or in an electric furnace, refines the metal and brings it to the required carburisation, while at the same time dephosphorising it. It then remains to bring the metal to the proper carbon content in the ordinary way by final additions.

This concludes the first portion of the paper, and the author believes that readers will share his conviction that the method of obtaining electric iron by the synthatic process is destined to continue to play a useful part in metallurgy which will as time goes on be requiring a more and more high quality metal.

The production of synthetic cast iron during the war has been considerable. It is not possible for the author to estimate at the moment how much has been produced at works other than those administered by the Keller Leleux Company at its works at Livet, Nanterre, and Limoges. The production of these three works alone exceeded 150,000 tons, while it should further be pointed out that Nanterre has been devoted to other manufacturers within the last eight months. It goes without saying that such an output could not be obtained solely from existing plants. These new plants are the subject of the second portion of this paper.

Part II.— The Process.

On June 20, 1914, the author read at the Livet Works a paper before the Sixth International Congress of Chambers of Commerce on the subject of this process of manufacturing synthetic cast iron, and giving the results he had accomplised since 1908, including more particularly an investigation of high tensile semi-steel obtained directly by the carburisation of steeel turnings of the electric furnace. At this period a scheme for a works for the manufacture of malleable iron was about to be carried out. This was, however, interrupted by the war. Directly after the specifications for projectiles of semi-steel appeared, the author took steps to produce a metal complying with the conditions laid down by the French Ordnance Department. By November 1914 such an iron had been produced and investigated corresponding with the following composition:

	Per Cent.
Carbon	2.9
Silicon	1.75
Manganese	0.50
Sulphur	traces
Phosphorus	0.5

The test results obtained were as follows:

Tensile strength, 50 kilogrammes per square millimetre; impact resistance, 60 blows (equivalent to fall of a 12-kilogramme tup from a distance of 89 centimetres on a test piece measuring 40 millimetres by 40 millimetres resting on two knife edges 16 centimetres apart, the distance of fall increasing 1 centmetre at a time until rupture occurs), whereas the ordnance requirements only specify a minimum of 25 kilogrammes per square millimetre for the tensile strength and 18 blows (equivalent to 44 centimetres)

The first electric furnace of 20 tons was started in 1914. The uniformity of the iron and the tensile qualities obtained led to its being immediately considered from the standpoint of shell manufacture. The Ordnance Inspection Department, after due examination, showed itself favourable and before the end of 1914 the first series of 220-millimetre shells of semi-steel yielded excellent results at the Bourges proof range.

Orders from the Department were the immediate result of these favourable trials. The manufacture of 220-millimetre shells of synthetic semi-steel was thus undertaken at Livet on a commercial scale from the commencement of 1915. A complete foundry was erected and furnished with electrical furnaces for the refining of the iron and the production, which was in the first instance at the rate of 50 shells per day, was raised in 1916 to 300 220-millimetre shells, together with 10 high-explosive 400-millimetre shells requiring 55,000 kilogrammes of raw metal.

In order to comply with the best practical conditions for running the foundry, the iron obtained in three primary furnaces is run into a ladle of 5 tons and poured into three 7-ton electric mixer furnaces each taking 400 kilowatts, to reheat the metal if necessary, and in any case to keep it hot during the period that iron is being used, and to check the quality. Despite the very uniform composition of the primary furnaces a carbon test, which only takes twenty minutes is carried out by the foundry staff before pouring, in addition to ascertaining the quality by a quench test which serves more particularly to check the silicon.

The mixer-container furnaces for steel are of the Ch. A. Keller type, that is to say they have a roof and doors. The electric current enters by a vertical electrode, and leaves through the conducting hearth, of the reinforced-puddle type (vertical bars plunged into tamped magnesite). A conducting hearth of this description is practically unwearable, being nonsusceptible to any cracking. If the bottom conducting surface of the hearth wears gradually lower, repairs are very easily effected by spreading over the bottom while still hot, a special conducting puddle consisting of magnesite and fragments of iron mixer in tar. All holes are thus easily filled up without either the framework or the working of the hearth being interfered with in any way. From a metallurgical point of view this method of repairs corresponds in principle with that employed for the hearths of open-hearth furnaces. The furnaces are, of course, of the tilting type which allows of any quantity of metal, no matter how small, being drawn off.

The liquid iron poured in is covered with basic slag, which forms a protecting layer, preventing oxidation and breaking the electric arc. When pouring is to be done, this layer is easily retained by a little brickwork or sand pocket at the entrance of the furnace spout.

Practice has shown the advisability of interposing these mixer furnaces, which keep the metal so that it can be checked from time to time by the technical staff, who thus acquire a high degree of skill, seeing the ease with which the metal can be held waiting. Generally speaking, it may be said that the metal remains an hour in the mixer furnace, including the time of pouring(for the filling up of these furnaces is carefully adjusted to correspond with casting operations in the foundry). The metallurgical adjustments are very easily carried out, as any additions, as well as the withdrawal of the test samples are effected through the working door. The practice described gives complete satisfaction; in particular it invariably ensures uniform metallurgical results, thus eliminating all rejections due to insufficient tensile strength.

The upkeep of the mixer furnaces is but trifling. The interior lining of the mixer lasts a couple of months, and the roof over three months. The electrode consumption is on an average 2 kilogrammes per ton of iron; the average power consumption is from 50 to 100 kilowatt hours per ton, according to the conditions prevailing in the foundry. A single workman is required for the working of the furnaces and he also looks after the tapping, the electrical manipulation of the tilting arrangements and the taking of samples.

The machining of the shells, which were originally placed out with subcontractors, was carried out at the Livet Works towards the end of 1916 under Ordnance inspection, and thus without the intervention of any transport, or the use of any coal except for the chemical composition, the manufacture of semi-steel shells from steel turnings was wholly carried out in one works. This concentration of plant reduced the number of rejections to a very small amount, not exceeding, when the necessary skill had been attained, 7 per cent. on the cast shells inspected.

The capacity of the electrical foundry at Livet could not keep pace with the output of casting metal which began at 20 tons per day, was subsequently increased to 60 tons, and later on reached not less than 300 tons during the period of maximum water-power supply. Several outside works manufacturing shell were supplied with the surplus output. These firms all testify to the uniformity and excellent quality of the iron supplied. The quality of the iron supplied to outside firms corresponds with the following composition, which complies with the best metallurgical practice, carbon about 2.75 per cent. and silicon about 2 per cent.; so that after a cupola melting the artillery specifications could almost be met without any addition of steel, as both recarburisation and reduction of silicon accompany fusion in this type of furnace. Each wagon-load sent out was accompanied by an analytical report showing what additions of steel and of ferro-silicon might be needed. Very often no such additions were required.

This method of working usually conducted to obtaining good metallurgical results in shell foundries. The care with which the analyses were made was carried to such a point that qualities specially standardised for carbon and silicon were supplied to smelters in order to check abnormalities due to remelting in certain cupolas.

Even the enlargement of the existing Livet Works has now become insufficient to deal with such a development.

Part III.—New Works at Livet and Elsewhere.

A new special works was laid down in November 1915 some hundreds of yards from the original works with which they were connected by railway. The new works were stared on July 12, 1916 first with a furnace of 80 to 100 tons and were subsequently enlarged. The building occupied an area of 12,500 square metres, and comprised more particularly four parallel shops. The first shop, which was 300 metres in length, and alongside the railway served for unloading the raw materials and more especially the steel turnings, which are handled by means of a powerful electro-magnet suspended from a high speed crane. The turnings are either used at once in the cycle of operations, or put into stock in a deep trench occupying a portion of the length of the shop, from which they are withdrawn by the same means. By this arrangement a 12-ton wagon can be unloaded in twenty minutes.

The second shop, which was situated between the unloading shop and the electric furnace shop, served for the preparation of the charges, which are mechanically raised by large bucket elevators to the furnace platform, where they are tipped on to the latter by small wagon loads at a time and heaped around the electrodes.

The transformers are housed in sheds built on reinforced concrete foundations on the level of the platform of the electric furnaces. This arrangement possesses the advantage of leaving the second shop entirely free, and also reduces secondary distribution to a minimum. Each shed contains the transformer panelboard which is connected with the central supply by means of an armoured cable, leading to a long upper gallery of reinforced concrete, in which are housed the buss bars and all the switches (registering meters and watt meters). This gallery which is just beneath the roof is capacious enough to allow of easy access, while its position isolates it as completely as possible from dust, and prevents any danger arising to the staff.

The third shop contains five Ch. A. Keller furnaces of the "electrodes in series" type arranged in line, four being of 2000 kilowatts and one being of 2500 kilowatts. The output capacity of this installation is 300 tons of synthetic iron per day. This output could not be maintained, particularly in 1918, owing to various circumstances which were, however, quite independent of the plant itself.

Loading the iron on to wagons is effected by means of an electro-magnet suspended from an overhead electric crane, which serves a line of railway parallel with the front of the electric furnaces. By this means a 10-ton wagon can be loaded up in fifteen minutes

The lay-out of this works provides for a complete unit of manufacture in transverse section for each peir of furnaces, this arrangement being repeated along the whole length and thus securing the best possible arrangement for the supply of raw materials and for the removal of the manufactured products, each unit having lines of railway along its sides and being thus connected up with both ends of the works. The haulage of the wagons is effected by electrical capstans placed throughout the plant. At one end of the works a shop at right angles to the shops just described has been laid down to house electrical converter furnaces to serve a steel foundry. The special synthetic iron employed for this conversion is poured into a ladle on the side of the furnace furthest away from the pig beds. The ladle can thus be conveyed along a longitudinal pit by an electric overhead crane so that its contents can be poured into the converting furnaces. This arrangement for casting from both the opposite sides of the electric furnace enables the material to be cast, very conveniently, either into pigs or poured into the ladles.

At the end of the plant are two large shops intended ultimately to serve as rolling-mills and to house the accessory appliances.

Part IV.—The Development of New Waterfalls.

The rapid extension of the use of synthetic cast iron led the Keller Leleux Company not only to lay down new works for its manufacture, but also to develop fresh waterfall supplies in order to increase the power resources at the Livet Works.

1. The Vernes Fall (7000 horse-power).—For this reason in August 1917 work was undertaken in connection with the Vernes Waterfall on the Romanche. This new hydro-electric works was put into operation in July 1918, and therefore was approximately in time to observe the requirements of the war. The nominal power is 7000 horse-power, the height of fall being 20½ metres. The hydraulic works comprise a subterranean canal, 208 metres in length, under the Livet Works, a tunnel of 15 square metres and 620 metres in length in the mountain and a reinforced

concrete conduit 3-6 metres in diameter and 132 metres long, ending in a reinforced concrete water chamber with special arrangements for the evacuation of the reflux waters. Two steel conduits of 2.5 metres in diameter feed the 3500 horse-power turbines of the power house.

This waterfall, which makes use of the water of the Romanche actually at the point of outflow of the Livet Works, required, therefore, neither a dam nor a settling pond. The additional power thus developed at the Livet Works corresponds with an increase in the output of synthetic cast iron equal to 25,000 tons per annum.

2. **The Bâton Fall** (700 horse-power).—Despite considerable difficulties in connection with the harnessing of this fall, which is 1100 metres high, the Keller-Leleux Company undertook operations towards the close of 1917 with the object of extending its share in the national defence by increasing its output. It is anticipated that operations will be completed during the current year, although it still remains to complete the tunnel of 1050 metres in length and situated at an altitude of 1900 metres, by which the water is led to the works and for the carrying out of which a winter station was established in 1917. It will also be necessary to complete a conduit (of a total weight of 400 tons) which will have to be clamped to the steep mountain side for a length of 1600 metres. The hydro-electrical machinery is on the point of delivery.

If the utilisation of the Vernes Fall may be regarded as one of the feats of the war, it is to be hoped that by a future triumph the Bâton Falls may be reclaimed for the purposes of the peace.

Part V.—New Electro-Metallurgical Works.

National Gun Foundry of Nanterre.—At the end of 1916 Mr. Albert Thomas, Under-Secretary of State for Ordnance, and Mr. Claveille, Director of Gun Manufacture, commissioned the author at the expense of the State to lay down and equip the works at Nanterre, for an output of 300 tons of synthetic cast iron per day, employing derived from the sector of the "Société d'Energie Electrique de la Région Parisienne," whose power-house had just been completed.

The electro-metallurgical works, which is known as the National Gun Foundry of Nanterre (Fonderie Nationale d'Artillerie de Nanterre), comprises seven furnaces, of which six are in operation, requiring 10,000 kilowatts. It was built in 182 effective working days, with the wonderfully active and energetic help of the "Société Générale d'Entreprises" for all contract work. It was put into operation on July 3, 1917. The works, which was designed for the manufacture of synthetic steely-iron for shell manufacture, at once realised its industrial purpose. The anticipated results were, indeed, surpassed, and the quality of the iron was very greatly appreciated by iron-founders on account of its uniformity and purity.

The consumption of materials per ton of pig for the 1650 kilowatt type of furnace employed was as follows:

	Kilogrammes
Steel turnings	1133
Coke	89.95
Electrodes	6.1
Kilowatt hours	815

The electro-metallurgical works, was connected to the Havre Railway, comprised an important network of sidings intended to accommodate trains of forty wagons at a time. The area occupied is 15,000 square metres. The works itself is composed of three sets of buildings, of which the largest consists of three parallel shops each of the same length, and the arrangement is practically the same as at Livet, which has already been described. At Nanterre, however, the electric furnace shops and the wagon unloading shops are combined and furnished with a wide-spanned overhead crane, which further accelerates working. The handling arrangements have been divided into two sections of 150 tons per day, each furnished with an overhead electric crane, for unloading raw materials, with an electro-magnet for the turnings and a bucket grab for the other materials, while in the furnace shop there is an overhead crane for loading the pigs on to trucks. The stocks of steel turnings for current use are stored at the two ends of the third shop, and are the electro-magnets into intermediate hoppers made of ferro-concrete. The various materials, such as coke and the slag constituents, are stored in the centre portion of the raw materials shop. They are crushed, after unloading from the wagons, and hoisted in large reinforced concrete bucket-hoppers, from whence they are delivered through holes in the bottoms to the trucks. The coke employed for carburisation goes from the crusher to a rotary fan drier, which reduces the moisture to less than 1 per cent. Two bins are always in use for holding the coke, one full for current manufacturing purposes and the other in process of being alternately filled. This system allows of the amount of fixed carbon, as coke, which is in course of consumption, being accurately known. The charge-mixing shop is adjacent to the raw material storage sheds, and comprises a longitudinal pit in which run the service trucks. These are raised by electric hoists to the electric furnace platform, each hoist serving two furnaces.

The electric furnaces are charged by the wagons being tipped on to cast iron travelling bands, which take the material to the electrodes. The furnaces are built in line at a distance of 30 metres apart from centre to centre. The transformers are housed in sheds on the level of the charging platform. The distributing system for the 3-phase 5000-volts electric current consists of armoured cables carried in a subterranean chamber alongside the longitudinal pit in which the wagons run, so that the man-holes give on to the side of the pit. Connection with incoming current and with the power station, is by means of seven armoured cables of 800 square millimetres in section, of which one serves as a relay.

The electric furnaces are controlled from a control station situated between each pair and is effected by hand, the variations being slight. The arrangements for lowering and raising the electrodes are likewise mechanical. The electric furnaces are of the Ch. A. Keller monophase type, with the electrodes in series.

After water sprinkling, the stripping of the pigs, still attached to the runners, is carried out by means of an overhead crane and a 2000-kilogramme electro magnet. The entire sow and pigs are raised and dropped in the space between the furnaces, the impact breaking them into separate pieces; the electro-magnet then lifts them and loads them on to wagons running along the front of the furnaces. A single workman can easily strip the bed, break up and load up the 150 tons produced daily by each group of three furnaces.

The manufacturing plant proper ends with a shop where the electrodes are prepared, agglomerated in sets of four, the individual rods being connected with the lead-in piece by a fused joint. The blocks so formed are taken by an electric hoist to the smelting shop, and discharged on the end of the electric furnace platform, from whence they run on rails to the different furnaces.

Another set of buildings contains the accessory plant, filling shops, the transformer house for turning three-phase current into continuous current, the pumps for supplying the works with water, stores, and foremen's offices, etc. The plant contains a very capacious stock pit for turnings, 150 metres long and served by an overhead electric crane carrying an electro-magnet, the wagons running beneath the crane. This store shed can hold 50,000 tons of steel turnings. The railway alongside of it is connected with the main lines of the works and with a wharf on the Seine furnished with an electric crane similarly equipped with an electro-magnet to unload the barges containing the steel turnings, which are collected from works in the vicinity. It also serves to load up the output. The finished iron to be placed in the stockyard is loaded up on wagons bv means of a crane running along the front of the melting shop. All these arrangements have given excellent results, and have reduced handling to a minimum. There are also well fitted laboratories and a medical service connected with the works.

Labour.—Labour was supplied by prisoners of war and by mobilised workmen, who are boarded and lodged by the works, which has put up for this purpose a number of huts, dormitories, and canteens.

In order to provide for future urgent needs the power supply of the electro-metallurgical works at Nanterre has been increased to 15,000 kilowatts, to be used in the nine monophase 1560 kilowatt furnaces housed in a melting shop 175 metres in length.

The Limoges Works. — Simultaneously with the undertakings created at Livet, the Keller Leleux Company, in co-operation with the Société Générale d'Entreprises, established a works for the manufacture of synthetic cast iron, the power supply being the surplus energy developed at the Eymoutiers Hydro-Electric Works, belonging to the Departmental Railway Company of Haute-Vienne.

The electric furnace, which is one of a 1000 kilowatts, was worked in 1916 in parallel with the tramway system, practice having shown that this arrangement is advantageous.

Villefranche Works.—A similar plant, the power capacity of which is 2000 kilowatts, has been laid down by the Keller Leleux Company at Villefranche, to use the surplus power developed by the Midi Company on its line from Perpignan to Bourg-Madame. This works has only just been completeed.

It is incontestable that the war has stimulated extremely rapid development of the manufacture of synthetic cast iron owing to the abundance of steel turnings and the practical difficulties of using them before 1916, with the result that a considerable quantity of French steel turnings used to be exported, chiefly to Italy and Spain. Since that time blast-furnaces have become large consumers, and the problem of what is their best mode of utilisation—either in the blast-furnace or in the electric furnace—now deserves further investigation. Questions of transport now play so considerable a part, that in this as in all other cases it is necessary carefully to determine from time to time which is, nationally, the most economic method of using them. Whichever way the question may be decided there is no doubt that a recarburising fusion by electric power derived from waterfalls constitutes the most economical mode of utilising such turnings, in so far as it involves a complete economy of coal. It is therefore towards electrical furnaces supplied by water power that we must look for the utilisation of steel turnings, although the post-war conditions may modify the existing situation. The possibilities connected with the manufacture of synthetic dephosphorised iron must depend in the first place on the supply of steel turnings, but ultimately on the difference between the cost of coal and the cost of developing water-power. The whole of the conditions will have to be reviewed later, when war conditions have yielded to conditions of normal equilibrium, but respecting which, for the moment, all forecasts are at present speculative. It will be seen none the less that synthetic cast iron has filled a useful gap in the production of pure iron and has rendered valuable help to the cause of National Defence.

BOOK REVIEW.

MINERALOGY, by F. H. Hatch, Firth Edition Revised, with 124 illustrations, 7 ins. by 5 ins. Boards, 258 pages with index and tables. Six shillings net. Sir Isaac Pitman & Sons, London.

This work by Dr. Hatch, past-President of the Institution of Mining and Metallurgy, and well-known as an authority on petrology and the geology of ores, was first issued in 1892, and has been reprinted three times, without revision. The present edition is rewritten and enlarged, but Dr. Hatch in the preface states he has been careful to retain the essential features of its original arrangement. New features in the edition are tables of specific gravity and the refractive indices of the more important minerals, which will be found useful for those engaged in mineral separation and microscopic work. In the reference to iron ores there is, probably through inadvertence, no mention of the hematite deposits of Wabana, Newfoundland, nor to any of the Canadian occurrences, except as these may be included in the references to the Lake Superior District.

STEEL INDUSTRY PLANS FOR B. C.

Establishment of a scrap and open-hearth furnace at Vancouver is proposed by the Department of Industries of British Columbia. The expenditure of approximately $500,000 would be involved. The committee dealing with the matter includes Major J. H. Martyn, Nichol Thompson and J. H. McVety of Vancouver. It is the intention of the committee to have full regard for the rights of vested interests, but the members think it is possible to unite all these interests under a common scheme in so far as essential equipment is concerned. The scheme will mean the utilization of all scrap and will mean ultimately, if successful, the establishment of a steel mill for the modern treatment of ore. The present scheme will include the manufacture of angles, round and half round, squares, bolts, spikes, nuts, rivets, chains, and other material of a similar nature.

The Low-Grade Ores of Ontario

Successful Beneficiation of Masabi Range Ores of Similar Character, suggests Similar Possibilities in Ontario.

By J. J. O'CONNOR, Port Arthur, Ont.

The successful development on a commercial scale, of Canada's enormous reserves of low grade iron ore, situated mainly in Northern and North Western Ontario, would do more to place this country on a sound, independent economic basis, than any project looking to production, that could be undertaken.

Few Canadians realise the enormous wealth in iron ore lying dormant and undeveloped within our borders. Most of them believe that we are without sources of supply, of this most necessary basic metal. They are not blameable for this opinion, so generally held, but feel that they are justified in holding it, in face of the fact that we now import 96 per cent of the iron ore used in Canadian blast furnaces, and in addition, import upwards of 100,000 tons of pig iron, and about $175,000,000 worth of iron and steel products annually.

During the past five years railway maintenance has been at the lowest ebb, railway construction practically nil, and all other forms of constructive development, almost at a standstill. We now find ourselves in the midst of a period of readjustment, and reconstruction, when these arrears of construction work must be caught up. With an immense mileage of railway improvements to make, and railway extensions to be constructed. Steel ships to be built as a necessary complement to our government owned railways, in pursuance of the adopted policy of a government owned merchant marine, for the expansion of Canada's foreign trade. With all other industrial lines to be developed and expanded, to enable Canada to pay its enormous war debt. There has never been a time in the history of this country, when the maximum of possibilities were as great as they are today, never has been a time when we were so much in need of our latent mineral wealth, as we are at present.

With 14,000 miles of railway on our hands, and more to follow, with traffic to find for this enormous mileage, for its maintenance and necessary extensions, together with other industrial needs, it would seem to be a fitting time for the government to come to the aid of the iron ore industry, in a practical way, and make Canada independent, instead of practically dependent, on foreign ores, as she is today.

At this time, when the Canadian dollar has lost a considerable portion of its face value, through over purchasing abroad, the logical course is to turn to our own resources, and make of them, assets in fact. No natural wealth can be considered an asset until it is developed.

Instead of importing over two million tons of iron ore annually, develop our own ore, help stabilize exchange, and bring the Canadian dollar back where it should be.

One of the greatest factors in retarding the development of Canadian ores, is the easy accessibility of United States, Lake Superior ores. Furnace men are able to import these high grade ores free of duty, at low freight rates, and consequently have paid no attention to our own ores.

Canadian blast furnaces have ben subsidized to the extent of $17,000,000, they have been placed on a sound basis at the expense of the neglect of our own ores. It is not reasonable to expect them to turn to the use of ores that must be beneficiated in some form, while other ores are so freely open to them.

That we have immense deposits of low grade beneficiable ores, has been amply proven. Particulars of the location, quality, extent, and amount of development that has been done on them, has already appeared in these columns.

The twenty-eighth annual report of the Ontario Bureau of Mines, 1919, just issued, says, on pages 31-32, "The fact that most of the iron ore mined in Ontario requires beneficiation before smelting has undoubtedly retarded the development of iron mining in the Province. There are very large reserves of ore in the northern and northwestern regions, but so far as the character of the deposits has been revealed, they are in the main low in metallic contents, and in some cases carry on objectionable proportion of sulphur." "Many of these deposits are contained in ranges of banded ore, composed principally of magnetite, but frequently carrying hematite as well. In these layers iron ore alternates with layers of silica or jasper, such layers varying in thickness from that of leaves in a book, to a foot or several feet. The intermixture of iron and silica being intimate, fine grinding is necessary before any method of magnetic concentration can be employed, and complete separation between the particles of ore and those of silica is difficult."

Much time, and a very large expenditure of money has been made on the Masabi range in Minnesota, in perfecting processes for the beneficiating of ores similar to our own. These processes have been brought to such a state of perfection, in their experimental plant in Duluth, by the Masabi Iron Company, that they are amply satisfied that they now have commercial success within their grasp.

Their plans are all complete, the money has been paid in, and construction is about to begin on their new plant at Argo, Minn. The original unit will entail an expenditure of $3,000,000. The new plant is to be constructed of steel concrete and wood. The first unit will have a capacity of treating 3,000 to 4,000 tons per day. Other units will be added as circumstances dictate.

The equipment will consist of crushers, ball mills, magnetic separators, sintering plant, etc.

Their product will be in the nature of a clinker, which is produced after the separation of the ore from the rock, by the sintering process. They are now experimenting with peat to be used in sintering. The product may be described as a clinker of high grade ore, free from moisture and all deleterious elements, very porous. The desirability of the product has been established by the preliminary tests, following the operation of the experimental plant in Duluth. They put three-quarters of a million dollars into the experimental stage of their enterprise, standing to lose it all, or make good.

If shrewd iron operators, on the richest iron range under development, in the world today, can make such huge expenditures for the beneficiating of low grade ores, it means that they have sufficient vision to prepare for a future that is certain to come, when high grade ores will be diminishing. They cannot last for ever at the present rate of fifty or sixty million tons per year.

Between 10 per cent and 15 per cent of the iron ore used in the United States today, is beneficiated. All of the New York and Pennsylvania ores undergo some treatment before smelting.

The enterprise and foresight shown by operators on the Masabi range in improving the grade of their ores, is increasing yearly, every season shows an increase in tonnage of beneficiated ores, over the preceeding one.

With this example before Canada, why should not something be done along the same lines for the development of our own iron?

Our ores in the main, lend themselves to beneficiation and much more readily than the ores to be treated by the plant mentioned above.

The Bureau of Mines report above referred to, says "Undoubtedly the iron ore deposits of Ontario will be called upon, and it may be at no distant date." With this authoritative statement, some measures of aid should be undertaken by the Government of the Province, aided by the Federal authorities to bring about the early exploitation of this natural resource.

The Province should undertake the diamond drilling of the various ranges, to be recouped for its expenditure, where merchantable, or beneficiable ores are located, contingent on expending the money so repaid, in further drilling on another range, and so on, until the whole of the ranges were gone over. If they would undertake to do this an experimental plant would be erected in this district, that would demonstrate the feasibility of creating, not only an iron ore industry, but a steel plant, rail mill, by-product plant, and all the subsidiaries that go with an iron and steel enterprise.

The railway mileage to be maintained, and the mileage to be built in the future, will be greater west of the Great Lakes, than in the east. This means at least \$1.50 per ton on steel rails, in favour of this point, as against any point east of here.

This form of government aid should not occasion fear on the part of the public that that any one man, group of men, or any one community would be the sole beneficiaries of the aid given, its benefits would be felt from coast to coast, no one section of the people would be so directly benefitted as the agriculturists. It implies the continuous flow of freight traffic. Prosperous communities would be built up, enlarging and bettering the farmer's market. More, and cheaper agricultural implements would be manufactured in Canada, leading to a solution of the tariff problems of the present.

The Federal government could give substantial aid to a beneficiating plant, without the expenditure of one dollar by admitting the heavy and expensive machinery necessary in such a plant, free of duty.

This is a concrete and feasible proposition, easy of accomplishments, that would demonstrate Canada's ability to stand on its own feet, in the matter of iron ore requirements.

Proposal to Establish a Testing Plant at Port Arthur to Demonstrate Feasibility of Concentration and Beneficiation of lean iron-ores of Port Arthur District.

Mr. J. D. Gilchrist, of Denver, Col. has spent the past fortnight at the head of the lakes, in an endeavour to establish an iron ore testing plant, to try out on a commercial scale, what he has accomplished in the way of beneficiation, in the laboratory.

Mr. Gilchrist's first visit to these iron ranges was made in 1901. At that time he realized that, in the main, they were of too low grade to be in demand at that period. However, his examinations, made with great care, convinced him that they would certainly be in demand at no distant day. Ten years later he spent a considerable time in again going over them, and was more than ever of the opinion that their time was fast approaching. Meantime, he was devoting his energies to devising methods for their concentration, and beneficiation, so as to render them commercially available.

He spent two months in the Summer of 1919, in sampling, and investigating various ranges in the Port Arthur district. He took large samples of the ore to his laboratory at Denver, and subjected to the most critical tests in concentration, and achieved results that convince him, that the time has come when these ores can be operated on a profitable basis, and a successful iron ore industry established here.

Mr. Gilchrist addressed several meetings of the city Councils, and Boards of Trade, of Port Arthur and Fort William, and exhibited numerous samples of concentrations obtained by him. These samples carried the assays of the ore in its natural state, together with assays of the concentrations, both heads and tails. He has demonstrated to his own satisfaction, that concentrations of 55 per cent iron content, is easily obtainable without very fine grinding, 20 mesh being the finest.

His proposal is, that the citizens of Port Arthur, and Fort William raise a fund of \$40,000 for the purpose of erecting, equipping and operating a testing plant here, and for securing leases on iron lands. This "pilot plant" would demonstrate on a commercial scale, the feasibility of his process, and place his claims beyond doubt. When this demonstration has been carried to a successful point, the plant would be scrapped, and a company formed with a large capital, for the purpose of building a steel plant, by-product plant, and all subsidiaries that are common to such an enterprise. The subscribers to the original fund to be taken in, on an equitable basis, in the company to be formed.

The Ontario government is to be asked, by way of aid to the industry, to diamond drill selected ranges. Where merchantable, or beneficiable ores are located by the drills the government is to be recouped for their outlay, conditional on their expending the money, so repaid, in further drilling, until the requisite amount of drilling has been done. The Federal Government will be asked to permit the free entry of all necessary machinery, used in the testing plant, and in the contemplated steel industry. Most of the machinery used will be of a very heavy character, much of which is not now manufactured in Canada. In this manner, both governments will be able to render substantial aid, without the expenditure of public funds, or, at least, of a minimum sum.

This proposal has met with a very favourable reception from the citizens. It is now in the hands of a committee, composed of citizens of the two cities,, who are formulating plans for carrying it through. It is

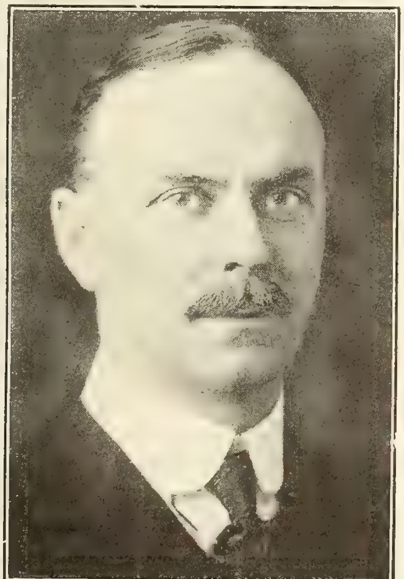
believed that local people will demonstrate their faith in our local ores, by investing in this enterprise, and that it will mark the begining of great iron ore, and steel industries.

There is ample precedent for such a beginning. With the experience of the Mesabi Iron Company, in their test-plant at Duluth, operated for a year, with such success that it warrants them in undertaking the huge expenditure in a plant to handle from 3000 to 4000 tons of ore daily, now underway, at Argo, Minn., on the eastern Mesaba range. The ores of the eastern Mesaba do not land themselves so readily to beneficiation, as our local ores. The former have to be ground to a fineness of 200 mesh. It is in the fine grinding that a large part of the cost of treatment is incurred.

Mr. Gilchrist has had years of experience on the iron ranges of Michigan and Minnesota.

PERSONAL.

Mr. Norman M. Campbell has resigned his position as General Sales Manager of the Canadian Ingersoll-Rand Co., and as a director of that Company, to take the position of Managing Director of the General Combustion Company, of Montreal. Mr. Campbell joined the staff of the Canadian Ingersoll-Rand Company in 1900, as Manager of the Toronto Branch, and was later appointed in charge of the Montreal office. Since 1910, Mr. Campbell has filled the position of General Sales Manager of the Company, and during his incumbency saw the Canadian Ingersoll-Rand grow from quite small beginnings to its present position as a large manufacturer and distributor of mining machinery.



Mr. Norman M. Campbell.

The General Combustion Company was recently incorporated in Canada, and in Britain, to introduce in these countries the "Oilgas" furnace, for heat- treatment, annealing, forging, etc., under the Sklovsky patents.

Mr. Campbell is an associate member of the Engineering Institute of Canada, a member of the Canadian Mining Institute, and a B.Sc of McGill University. During the construction of the Dominion Iron and Steel Company's plant in Sydney, Mr. Campbell was assistant engineer in the waterworks department.

Company Notes

ANNUAL MEETING OF DOM. FOUNDRIES AND STEEL CO., HAMILTON.

No action was taken on dividends nor was there any discussion as to the sale of the company at the annual meeting of the Dominion Foundries and Steel Company, held at Hamilton, Ont., on March 10th. According to the statement presented the earnings for the year were $634,000 and the prospects for the coming year were stated to be very bright. To meet the anticipated business additions are being made to the plant and there are many orders on hand to go on with. C. W. Sherman was elected president and A. G. Wright secretary.

The financial report showed that the company has $12,000 in cash, a plant valued at $2,000,000 but which could not be replaced for nearly double that amount, and $651,000 in its investment fund. There is no bonded indebtedness and after deducting $57,600, equal to eight per cent on the outstanding preferred stock, a balance of $596,400 remained, equal to approximately 24 per cent on the common stock. During the past year dividends totalling 15 per cent were paid on the common stock.

It was stated at the meeting that the company owns the entire capital stock of the Adirondack Steel Company. The company's plant, which is situated at Albany, N. Y. is under construction and is expected to be in operation in June next. Before the end of the present year the large new plate mill being constructed at Hamilton should be in operation.

1919 REPORT OF NOVA SCOTIA STEEL AND COAL COMPANY.

Some of the main comparisons between the operations of 1919 and the previous years are as follows:

	1917 Tons	1918 Tons	1919 Tons
Coal mined..............	580.310	502.051	550.965
Coke made......	106.617	110.829	45.462
Limestone quarried......	76,659	77.162	33.410
Dolomite quarried........	6,573	7.827	2.187
Pig iron made...........	86,153	92.174	35 676
Steel ingots made........	127.808	129.796	58.238
Steel ingots cogged......	122,745	125.161	54.645
Steel billets re-rolled.....	122,869	104.753	44.468
Total shipments of finished steel, forgings, etc., from New Glasgow	101,609	93.343	44 051

The volume of business was smaller, being in 1919 $6.889.941 compared with $11,525,779 in 1918. At the present time the company reports more orders on hand than at any time since the end of 1918.

The consolidated balance sheet of the Company and its subsidiaries showed combined profits for 1919 of $2.193,304 compared with $3.535,525 in 1918. Net earnings after paying bond interest and preference stock dividends, leave an amount equal to six per cent on the common stock. Total assets are reported of $35.714.907, comparing with $35,288.917 at the end of 1918, showing a gain in assets, after payment of all fixed charges and common stock dividend of $426,000.

The surplus carried forward totalled $2,726.461, compared with $2.616.584 at the beginning of 1919.

While the earnings are sharply lower than those of 1918, the results of operations for 1919 must be regarded as highly satisfactory in view of a

reduction in turnover of almost five million dollars when compared with 1918, and in consideration of the fact that during the first seven months of the year the demand for iron and steel would not permit of operation of the blast furnace and open-hearths at Sydney Mines, and that the demand for coal did not revive until the Autumn of 1919.

From an operating point, the year was one of little demand, and enforced reduction of production. Under these conditions, the performance of the Company in earning sufficient to pay the fixed charges and bond interest, plus six per cent on the ordinary stock, and in increasing the gross assets by almost $500,000, indicates that with the existing brisk demand for all the products which the Company and its subsidiaries manufacture and produce, both coal, iron and steel products and cars, the earnings of 1920 should approach those of 1918.

DOMINION IRON & STEEL COMPANY'S WAREHOUSE DESTROYED BY FIRE.

The electrical warehouse of the Dominion Iron and Steel Company was destroyed by fire on the 7th March, during a heavy gale. The loss is serious inasmuch as electrical materials are hard to replace at this time. The loss is estimated at $100,000, fully covered by insurance.

DOMINION STEEL COMPANY RE-OPEN BAR MILL

The Dominion Steel Company is re-starting the Rod and Bar Mill, which has been idle for some time owing to scarcity of orders. Sufficient domestic orders have now been received to justify the mill in starting work again.

The 7,500-ton rail order for the Roumanian Government is completed, and as no further orders have been booked, the rail-mill will be closed temporarily

The Bessemer converters, which has not been in use for a number of months, are being re-lined, and the repairs will occupy about two months.

The 16″ commercial mill, which has been operating on single shift for a number of weeks, is being double-shifted.

The nail and wire mills are working to capacity.

Early on Sunday morning, Feb. 29th, fire, caused by hot cinders destroyed the structural steel plant of the Reid and Brown foundry at 63 Esplanade street, Toronto, causing damage estimated at $50,000. The blaze broke out at 5.55 and the building was almost totally destroyed in three-quarters of an hour. Hugh S. Reid, Secretary-Treasurer of the company had just returned from a trip to New York. He estimated that the damage to the building would be $30,000, and to the contents $20,000, all of which is covered by insurance, Mr. Reid stated that the firm would re-build at once.

The death took place in Woodstock Ont., on March 1st, of Thomas C. Stewart, one of the best known business men in Ontario and for many years mechanical superintendent and travelling representative of the James Stewart Manufacturing Company of Woodstock, manufacturers of stoves and ranges. Deceased was born in Hamilton, 76 years ago and was a son of the late James Stewart, who founded the Stewart stove business in Hamilton, in 1845. He went to Woodstock 28 years ago.

NEW MONTREAL SALES OFFICE.

The Engineering and Machine Works of Canada, Limited, St. Catharines, Ont., owing to the rapidly increasing demand for their products consisting of boilers of all types, horizontal, vertical, locomotive and marine, tanks, plate work of all descriptions, etc., and particularly in connection with their recent and very successful venture, the manufacture in Canada of the Keystone Light Traction Excavator, Model 4, have found it necessary to open another Eastern Sales Office in the Birks' Building, Montreal, where inquiries can be more quickly and satisfactorily handled. This is in addition to their Sales Office in the Sun Life Bldg., Sherbrooke, Que.

NEW TRACTOR CO. FOR CANADIAN FIELD.

Group of Montreal and Toronto Industrial Interests Form Company for the Manufacture of Chase Tractors in Canada.

Toronto will be the headquarters of another large Canadian industrial organization, as a result of the formation by leading financial and industrial interests of the Chase Tractors Corporation, Limited.

It is reported that the company has taken over the business throughout Canada of the Chase Motor Truck Co., of Syracuse, N. Y. The company has also secured a large plant adjoining the Canadian National Exhibition grounds, in Toronto, which will give it facilities on the main lines of the Canadian Pacific and Grand Trunk Railways.

The Chase tractor has established for itself a reputation of being one of the most successful machines of its kind in the world and it is the intention to manufacture tractors at the Canadian plant for the requirements not only of the Canadian market, but also for all parts of the British Empire.

The new company will have a capital stock of $1,000,000 8 per cent, cumulative preference stock, of which $750,000 will be issued at present, and $1,000,000 of common stock, all of which is now issued. The Montreal and Toronto groups who are connected with the new company, include R. J. Cluff, president; T. P. Birchall, vice-president; W. J. Cluff, vice-president; James Whalen, Senator Curry, R. M. Wolvin and J. W. Norcross.

The management of the new company will be in the hands of the Cluff brothers, both of whom have been indentified with the management and operation of several successful manufacturing concerns, among their biggest undertakings being the Galt Brass Company and the Cluff Ammunition Company.

It will be the policy of the company to manufacture its tractors from the highest grade of materials obtainable, irrespective of cost. This policy does not allow of as large a profit on each individual machine manufactured, but the company will undoubtedly derive the benefit in the long run, by establishing a record for the Chase tractor and at the same time making a satisfactory profit. This tractor has already been successfully manufactured in the United States and it is stated that the Canadian Company already has orders on hand sufficient to take care of its entire output for several months.

The Central Foundry Company has commenced operations at Georgetown, Ont., with a staff of twenty men. The President is A. L. Wynston and the Secretary-Treasurer, E. J. Selford.

The Annual Meeting of the Canadian Mining Institute

Toronto, March 8th to 10th, 1920

Matters of interest to the Iron and Steel Section of the Institute, reported by the Editor.

A Joyous Meeting.

Three things helped to make the Toronto Meeting a happy one, namely; the efficient spade-work of the Local Committee in preparation for the meeting and the entertainments; the presence and active participation in the meeting of a large number of members returned from the war; and the special care taken to ensure the presence and comfort of the ladies. The combination of these circumstances, with others that might be named, gave to the meeting from the first a keenness and elation that redeemed it from stodginess, and sustained the interest throughout an unusually full programme of work.

The reception of the Institute by the City of Toronto was most courteous and hospitable. The Institute was invited to luncheon by the Mayor and Civic Corporation, a mark of honour that has rarely, if ever before, been shown to it, and one which the retiring President, in thanking the Mayor and the City, accepted on behalf of the mining industry of the country as a recognition of the influential and representative position now generally accorded to the Canadian Mining Institute. The compliment paid to the Institute was not less marked than the appreciation it evoked from the members in attendance.

The Government of Ontario also, by the presence of Lieutenant-Governor at the Annual Dinner, and by the attendance of the Minister of Mines both at the opening session, and at the dinner, conferred distinction upon the Toronto meeting.

In addition, the most generous assistance was given by the Mines Department of the Province both before and throughout the course of the Meeting.

The sessions were so full, and the various events of the Meeting followed in such quick succession that the visitors did not see much of the city itself, but in no place has the Institute been more signally honored at its Annual Meeting than in Toronto.

The Minister of Mines welcomed the Institute to Toronto, and among other matters mentioned the question of iron-ore bounties, remarking:

"The Government had not committed itself to a policy of granting iron-ore bounties, and did not feel disposed to do this. In British Columbia three dollars per ton had been offered as a bounty for pig-iron made from local ores. This offer has not been taken up as it should be and I believe that in the case of our own ores, the time will come when they will be of the utmost importance, if it is really necessary they should be developed. The electro-thermic process of reduction of iron-ores is stated by competent authorities to be a feasible one, but our drawback is lack of electric power. We have not, however developed more than one-sixth of our own water-powers in Canada, and it is most important that we should do this if we are to develop our iron-ores."

The Mayor of Toronto stressed the necessity to develop our water-powers, and referred to the enormous importance of the Chippewa scheme. The deepening of the St. Lawrence waterway, and the utilisation of the powers that can be obtained from its long and falling course to the Atlantic was worthy of all help.

Mr. Church asked the mining executives to assist in every possible way the education of university students, and particularly mentioned employment in the long vacation.

The retiring President, Mr. D. H. McDougall, of the Nova Scotia Steel and Coal Company, delivered the Presidential Address, which will be found elsewhere in this issue.

Mineral Statistics.

Mr. John McLeish presented the Preliminary Report of Mineral Production for 1919, and pointed out the transitionary character of the year.

In the decline and recovery of the production of structural materials, in the increased value of non-metallics (which are chiefly composed of fuels), and in the astonishing rise of the production and values of metallics during the war period, and the much smaller figures of 1919, may be traced the chronology and effect of the War.

The progress of the by-product coke-oven industry in 1919 makes interesting reading. During that year there were completed 60 Koppers Ovens at Sydney, 25 Willputte ovens at Sault Ste. Marie, and 30 Lomax ovens, at Anyox, B. C. The imports of coke fell from 1,165,590 tons in 1919 to 383,374 tons in 1919. This not displeasing reversal is not altogether due to the larger coking capacity of Canada, some of it being of course, due to the slackness in steel production during the first half of 1919, but the additions to Canada's plants have a good deal to do with it, and from now on, it is hoped that importances of coke will lessen in quantity. It will be still more gratifying when Canadian coke is made from Canadian coal. An illuminating statement in Mr. McLeish's Report is that the quantity of coke-oven gas recovered in 1919 was 9,340 million c. ft. or the equivalent of one-third of the total production of natural gas in Canada.

Next to the coal production, the output of iron ores is the most disappointing feature of the mineral record of Canada in 1919. Shipments from Canadian mines were the lowest recorded in 19 years, amounting only to 195,970 tons.

The quantity of iron-ore charged to blast furnaces in 1919 was 1,752,585 tons, of which 78,391 tons were of domestic origin, or 4.4 per cent. Of the imported ore 519,722 tons came from Wabana, Newfoundland, and the remainder, 1,154,473 tons from the United States.

Pyrites, molydenum, graphite, chromite and magnesite all show large declines. The records of 1919 can hardly be considered as representative of the ability of Canadian mines to produce these minerals profitably in peace time, but the outlook for all these minerals, particularly for those which are used in alloying steel, is not by any means dark.

As a measure of the importance and stability of Canadian mining, the year 1920 will be more accurate than the figures of 1919. The most reassuring feature

that we can hope to see recorded is an increase in the production of coal in Canada, and conversely, if such an increase is not recorded, there will be adequate ground for grave anxiety.

Mr. Theo. Denis, Superintendent of Mines for Quebec was able to report that the mineral production of Quebec, "in the first after-war year, was the highest "in the history of the Province."

Mr. T. W. Gibson, in referring to the mineral production of Ontario mentioned that new developments during 1919 included the completion of the British-America Nickel Company's Refinery at Deschenes near Ottawa, and the new smelter of this Company at Nickelton, Ont.

Iron and Steel Papers.

A number of papers of interest to the Iron and Steel Section had been arranged for, but unfortunately none of them were given at the meeting. Mr. G. C. Mackenzie's paper on "Ferro-Alloys in Canada, was looked forward to, but at the last moment Mr. Mackenzie was unable to get to Toronto. Two papers on the Plate Mill of the Dominion Iron and Steel Company at Sidney were in course of preparation, but were not finished in time for presentation. It is expected these papers will be read at the Annual Meeting of the Mining Society of Nova Scotia at Glace Bay in May next, and will appear duly in the Transactions of the Institute. Mr. F. E. Lucas's paper is also expected at the Glace Bay Meeting, and deals with "Economies in Steel Plants".

Molybdenite in the Ottawa Valley.

Dr. M. E. Wilson described with the aid of lantern slides the occurrences of molybdenite in the Ottawa Valley. From an economic point the work so far done, and the extent of the deposits as revealed by actual mining, show that there would be steady work for a number of mills for many years should the market price of the mineral allow profitable operation of the known deposits.

The Iron Ranges of the Michipicoten District, Ont.

Mr. W. H. Collins, of the Geological Survey, spoke on the iron ranges, and gold occurrences of the Michipicoten District and the vicinity of Goudreau. An abstract of Mr. Collin's report on the work done by the Survey in this region was contained in Iron and Steel of the last issue. (see February number, page 35.)

The most interesting portion of Mr. Collin's remarks was his description of the attempt made to establish a definite stratigraphic succession within the Keewatin complex of the rocks immediately associated with the iron ranges. The general succession of basic volcanics, banded silica, pyrite, siderite and acid tuffs, in the order given was found to apply to the Michipicoten District. If the top and bottom of the known ranges could be determined, then this succession could be used to guide with some accuracy the course of future exploration.

The faults encoutered had a tendency which in nine cases out of ten was to the left, and displacements of 6,000 feet of horizontal throw were frequent.

With regard to the Houldsworth pyrite deposit, about 900,000 tons of high grade pyrite were under development, and Mr. Collins suggested the possibility of further deposits of this kind being discovered.

Dr. Goodwin mentioned that in 1912 he was summering in the Magpie District, and had at that time noticed the difference of texture on the rocks on the upper and lower contact of the iron formation, and was able to confirm from his recollection some of the features brought out by Mr. Collins.

In answer to Mr. Bradley Stoughton, who asked whether the ore could be used without concentration Mr. Collins said that Mr. Cowie of the Algoma Steel Corporation was present, and could give exact information. The siderite runs about 35 per cent iron, and by roasting it can be raised to 51 per cent iron. The ore is almost self-fluxing.

Mr. Cowie said that after driving off the sulphur, the roasted ore contained from 50 to 52 per cent iron, and the manganese content was increased up to as high as 3 per cent. At the Helen Mine, there was an immense deposit and the next generation would still be mining siderite. There was 150 million tons, and all that was required was a bounty to enable it to be opened up.

In the evening session on Monday, the 8th, Mr. J. C. Nichols, General Superintendent of the Mining and Smelting Division of the International Nickel Company described the operations of the Creighton Mine and the Smelter at Copper Cliff. A description of these plants was contained in the last issue of "Iron and Steel," page 9, q.v.

Mr. Nichols mentioned that at the smelter, pulverised coal had been used for nine years, without any trouble, notwithstanding that coal containing 13 per cent ash had been used.

At the concluding session of the meeting, Mr. J. A. Evans dealt with the minerals and producing mines of Eastern Ontario. Mr. Evans urged the payment of a bonus to enable the iron ores of the Marmora district, which are magnetites, to be developed by the electric furnaces. He referred to the vanadium and other rare metal content of some of these ores.

The Annual dinner was held on Wednesday evening the 20th, and as the guests of the Institute there were present the Lieutenant Governor of Ontario, the Minister of Mines and representatives of the Board of Trade of Toronto and sister societies.

The retiring President announced the resignation of Mr. H. Mortimer Lamb, and took the opportunity to express his personal appreciation of the Secretary, and asked permission to voice what he believed to be a general opinion "that the present esteem in which the "Institute is held, and the harmonious nature of its "membership, is to a very large extent the result of "Mr. Lamb's services."

Referring to Mr. Whiteside's incumbency, the retiring President bespoke the hearty support of the members. Mr. McDougall said that the new President represented that part of Canada which contains the largest coal reserve we have, which "is equivalent to saying that it will some day be the most important industrial and political factor in our national economy. The increased interest taken by the West in Institute affairs, is I believe, the best indication of our vitality and ability to read the signs of the times."

Mr. Bradley Stoughton, whose remarks are always anticipated by a pleased preliminary expression on the faces of the members, expressed his sorrow at Mr. Lamb's resignation and referred feelingly to their personal friendship.

Mr. Whiteside, the new President, spoke most appreciatively of Mr. Lamb, and asked the members to rise and drink his health, which was done with a will.

Presidential Address Delivered to the Canadian Mining Institute at the Toronto Meeting, March 8th, 1920

(By the retiring President, D. H. McDOUGALL.)

It is the custom for a retiring President either to review the year's events, as they affect the business of the Institute, or to speak with particular reference to some phase of Canadian mining.

I propose at the dinner to say a word on Institute affairs, but today would ask your consideration of some circumstances connected with the economic utilization of our national resources.

First of all, I would propound two statements, as the text of my remarks, which, made from this Chair, may strike you as unusual, and possibly heretical. The statements that I would make are that the natural resources of Canada are:

a. Very specialized.

b. Not inexhaustible.

I am aware that it has been the custom for many years to refer to our national resources by such terms as "illimitable," "immense" and "boundless," and, while these phrases may have been warranted when our people numbered a few millions, is it not perhaps time to take stock of our national assets in the light of future population, which may within the lifetime of those present here be doubled, or maybe trebled?

Canadian views have possibly been colored by reflection of those of our friends in the United States, whose prodigal natural resources have been a revealed phenomena of modern times. The World has not been before, and cannot see again, such a treasure house as the territory now known as the United States of America was when the white man first commenced to mine those resources, without much thought of the future.

In coal, iron, gold, silver, copper, zinc and lead; in the great forests of oak, pine, cypress and walnut that formerly existed, in agricultural possibilities and variety of climate, there never was so fortunate a land seen by white men, nor ever can be seen again in its unspoiled and intact pristine wealth.

But, in Canada, have we so great an accumulation of potential wealth? It is much to be doubted. Our wealth is truly vast, but relatively, we have certain distinct limitations, which, if we will admit them now, and proceed in that wise and prudent manner which has become a proverb, to "cut our coat according to our cloth," we may to a large extent offset.

Three basic requirements of our national life are, in their natural order of importance, coal, iron and wood, and, if we enquire carefully into the extent of our national resources of these three essential materials, their limitations, so far of course as our prospecting and the progress of scientific research today have led us, will be disclosed.

To deal in order, and very briefly, with these three basic materials:

Coal

Our coal deposits do not include anthracite, barring some anthracitic coals of small tonnage quantity in the West.

Our bituminous coals are concentrated in widely scattered localities—not, **as yet,** the most populous parts of Canada—and the gap between is wide and important.

With the exception of the great coalfield of Alberta and eastern British Columbia, which is of course essentially one deposit, we have remaining only the coal deposits of Vancouver Island, New Brunswick and Nova Scotia.

The great reserve of the two coalfields of Vancouver and Cape Breton Islands is under the sea, and, in regard to both these widely separated localities, the extent of the coal reserve depends on the progress that science will make in providing the means to transport light, air and motive-power over long tracts of underground passages.

The limits to the mining of coal imposed by great depth of cover, and by distance from shore, are not known, because they have not been tested, but it may be confidently presumed that these limits will be widened as human knowledge is increased by experience, and I merely wish to emphasize that the limitation exists.

In the same manner the removal of the present obstacles to the utilization of the low-grade lignites of the West rests with the advances of applied science, as does also the means of making Canada independent—as far as may be—of importations of anthracite from the United States.

Iron.

Canada's position in regard to iron ore is deducible from the definition of commercial iron ore which is contained in the Encyclopedia Brittanica article on "Iron and Steel" by Dr. Henry Marion Howe, of Columbia University, who writes:

"Whether a ferruginous rock is or is not ore is purely "a question of current demand and supply. That is ore "from which there is a hope that metal can be extracted "with profit, if not today, then within a reasonable time."

Our iron-ores, so far as we know them consist of large occurrences of ore of relatively low iron content. Their utilization will depend on the progress made in concentrating these lean ores to compete economically with richer ores. This again is a matter for practical scientists, and some progress has already been made in this direction.

Wood.

The inroads that are being made upon our forests are a matter of notoriety, nor are these inroads accompanied by anything approaching adequate reforestation. Indeed, it is doubtful whether in some instances reforestation is practical.

Enquiry will prove that timber lands are daily increasing in scarcity, and therefore in cost, and our limitations in Canada in this regard are not only distinct, but actually alarming

What I have said regarding these three basic materials is quite probably true of other essential things, but these do not so properly concern us as a Mining Institute.

One general conclusion we may draw, namely, that efficient and full use of our resources is dependent upon the progress of science, which, applied to their limitations, and supplementing their deficiencies, will have the effect of increasing their quantity and duration.

Dealing now with my second statement, and with those natural resources that I have called "specialized," I would direct your attention to the fact that Canada contains almost the world's reserve of nickel, asbestos and cobalt.

These minerals are chiefly important in being necessary to certain large industries, and, if this word is permissible, they are minerals possessing a "strategic" value, inasmuch as our almost exclusive possession of these minerals should enable us to drive a fair bargain with those nations that possess essential natural resources with which Canada is somewhat meagrely or unevenly supplied.

The members of the Iron and Steel Section of our Institute have not been slow to comprehend the growing importance of alloy steels, but this is an industry that Canada should strive to make a national speciality. We have large water-powers and the means of generating with comparative cheapness large quantities of electricity. Canada possesses, as mentioned, a preponderance of the world's nickel and cobalt, and in addition she is supplied with smaller quantities of chrome, molydenum, and magnesite—from which magnesium is obtainable. As a producer of synthetic steels, the variety of which is now immense, Canada only requires for success the development of trained metallurgists, for she has all the natural resources necessary.

The dominance of Canada in asbestos production and her important contribution of amber mica, should enable us to take an overshadowing position in the electrical industry, in which these two products find such varied and indispensable employment.

With reference to many of the ores of precious metals found in Canada it is well-known that their complexity of composition has been a deterrant to earlier profitable development of many deposits, but Canada today can boast of great strides in the processes of recovering the precious metals. So marked is this feature of Canadian mining, that during the past year, the members of the Canadian Mining Institute decided by a preponderating vote to change the name of the Institute as a recognition of the important status of the metallurgist.

What conclusion do these considerations lead us to? Inevitably, I think, and quite unmistakably, to a recognition of the importance of applied science to our young nation, and if this conclusion be admitted, then I think it will be necessary for the Canadian people to entirely revise their valuation of the scientific worker.

The Canadian Mining Institute in common with our sister societies, has for years urged greater recognition of students of science, of the universities and institutions of scientific learning, and of those civil servants charged with the development of the resources of the mines, the forest, the farm and the sea.

The salaries paid to those engaged in demonstrating in our Universities, and to civil servants engaged in scientific work, are so inadequate as compared with the rewards available by accepting employment with any of the large industrial companies in the country that the average scientific worker in our universities and Government service is compelled to choose between carrying on at a great personal sacrifice the work in which he is engaged or relinquishing it and accepting employment outside his present duties which will at least be sufficiently remunerative to provide the necessities of life.

Among others, there is one branch of the Civil Service—I refer to the Geological Survey—which has never been appreciated at its true worth. No Canadian Government has yet voted a worthy appropriation for the purposes of the Survey. It has always been hampered in its work by an inadequate number of workers, inadequately paid; and this deplorable, but I think undeniable fact, arises from a fundamental misconception of its importanse. The Canadian people does not know what advantages flow from applied geological research, and, largely for this reason, it does not care. I suggest that here is a direction in which the Canadian Mining Institute can do useful work. We should fully consider the work of the Geological Survey and should present to the Government a memorandum of how we conceive its usefulness can be maintained and enlarged, and then back our recommendations by the entire influence of the Institute. Certain steps have already been taken and these steps should be supplemented to the fullest possible extent. Unless we ask for what we want, and ask plainly and urgently, we shall go wanting.

Canada is not a country where wealth is easily gained, but it is a country not yet fully known, not half-prospected where in the past sincere work has almost always reaped a satisfying reward. What we, and our children, will get out of Canada will be in exact measure to what we put into Canada in the way of brains and work. We have great national wealth, but none to waste. We have problems and limitations, but, if these are properly tackled we can lead the world in many things. Only, we must give up talking thoughtlessly of our "boundless" natural resources, and prepare, by fostering science and encouraging scientific workers, to get the best out of our country, which may well prove to be something that will not only pleasantly surprise ourselves, but more favored nations also.

Further, our problems should be studied in the light of what has been accomplished in other countries, and this should not be left to that small proportions of our people that can afford out of their resources and time to go abroad

Nickel Coinage Advocated by Canadian Mining Institute

An interesting feature of the Toronto Meeting of the Canadian Mining Institute was the discussion on Nickel Coinage, which was opened by Mr. MacDonald of the International Nickel Company. Mr. MacDonald said the press articles advocating nickel coinage in Canada had done so largely from the standpoint of national pride in our national metal, but while he did not minimise the usefulness of sentiment, he desired to set forth the very substantial advantages that nickel was intrinsically possessed of. The use of nickel in coinage dates back to 235 B.C. in Persia.

Following are some of the main points made by Mr. Macdonald:

Seventy-four countries have adopted some form of nickel coinage, and eleven countries have adopted pure nickel, namely, in the following order of date:

Switzerland, 1881; Austria, 1892; Italy, 1901; France, 1903; Serbia, 1906; Mexico, 1910.

Properties possessed by pure nickel are responsible for its constantly increasing use in coinage, among which may be named:

a. Stability of value of the metal.
b. Desirable appearance.
c. Resistance to wear, corrosion and oxidation.
d. Malleable and susceptible to the die.
e. Difficult to counterfeit.

Mr. MacDonald compared the qualities of nickel with cupronickel and other alloys, with bronze and aluminum, and with silver for coins of low intrinsic value. Aluminum is too light. Cobalt is too hard. Nickel-copper, after use, assumes a greenish cast which is displeasing. Appearance of bronze coins becomes unattractive in use, and if used as tokens for coins of higher value can be easily counterfeited because of ease with which metal can be worked. The wear is also considerable, amounting to about one per cent per annum.

The speaker quoted a table of figures showing resistance to abrasion established through experiments by the Swiss Government, giving nickel by far and away the lead in all suitable coinage metals.

Mr. MacDonald strongly urged the adoption of a five cent coin in place of the small and inconvenient coin of silver now used, and suggested the replacing also of the ten cent silver coin by one of pure nickel. The nickel 5c coin would be same size as the present silver 10c coin, and the 10c coin would be the size of the present U. S. nickel.

The seignorage of the Government would in this event be in excess of $500,000 per annum. If the present silver 5c coin was returned and nickel coinage substituted, the Government could recover silver which cost 70c an oz. and sell it at the present market rate. Should half the existing silver coinage represented by 5c and 10c pieces be so treated, a gain of one and one-third million dollars would result.

Mr. Corless, in response to an invitation by the Chairman to speak, said the matter had been entirely covered by Mr. MacDonald.

Dr. Coleman said he had advocated nickel coinage for many years, and would strongly suport any move that the Institute could make to have nickel substituted for silver in our two smaller coins.

Mr. Gibson said it was expedient and advisable for the Canadian Mining Institute to make some active move to assist the Government in its consideration of this question. Sentiment was not a negligible thing in national life, and he thought that the minting of nickel coin would strike a responsive note of pride throughout the country. The 5c. coin is entirely too small, and utterly inconvenient to handle, as those who had seen a lady fumbling in her purse with gloved hands for a 5c. piece on a cold day could realise. The coin should be of pure nickel. Nickel alloy becomes greasy and malodorous. To test this question, Mr. Gibson said he had for many years carried a few pure nickel and nickel alloy coins in his pocket. The nickel coins were as bright and attractive as when newly minted. The nickel alloy coins were dull and unsightly. He urged the passing of a resolution asking for pure nickel 5c and 10c coins.

Dr. Miller (who was in the Chair) read from the Hansard some remarks of the Finance Minister who held office when the Canadian Mint was established in 1901, and at that time the adoption of a nickel coinage was urged. The Minister of Finance said: "To a certain extent this desire for nickel coinage has been the outcome of legitimate national pride. No doubt this feeling has influenced the establishment of the Mint". Dr. Miller said: "The case is proved. What shall we do about it?

Mr. Gibson moved, and Mr. A. J. Young seconded the following motion:

"The Canadian Mining Institute desires to go on record, and would strongly recommend to the Dominion Government the advisability of introducing nickel coinage at the earliest possible date."

There was no dissent from the motion.

Mr. Macgregor said that a certain amount of educational work would be necessary, and that it was desirable that some member of the House would raise the question at this Session. He moved that "We request the Council to procure the assistance of some member of parliament to bring about a discussion on the question of nickel coinage at the present Session, and that the full powers be given to the Council to assist in any way possible. Dr. Porter seconded and the motion was carried. A further motion was made and adopted that a copy of Mr. MacDonald's paper would be forwarded to the Minister of Finance.

It may be mentioned that a very full exposition of the advisability of nickel coinage will be found in the description of the Mond Nickel Company's operations which was issued in 1918. This description contains reproductions of all the nickel coins in use throughout the world at that time.

POSITION WANTED — Metallurgist and Chemist, University graduate with 6 years practical shop and laboratory experience wishes to connect himself with progressive concern where ability and results will be recognized. Have had a wide experience in the heat treatment, chemical analysis, physical testing and metallography of iron, steel, copper, brass and other non ferrous alloys. Can organize laboratory and handle shop organization. Best of references. Reply to Box 100, Iron and Steel of Canada, Garden City Press, Ste. Anne de Bellevue, P. Q.

INDEX

IRON & STEEL OF CANADA

Vol. II. FEBRUARY, 1919–JANUARY, 1920

-:- EDITORIAL -:-

The Ferro-Alloy Industry

In this issue will be found abstracts from a paper read before the Boston Meeting of the American Electrochemical Society during the week ending April 10th. The paper details the progress of the ferro-alloy industry, during the past five years, and deals particularly with the industry in the United States, as compared with and as affected by ferro-alloy manufacture in Europe, under normal peace time conditions. The history and present position of the ferro-alloy industry in the United States is similar to that in Canada, and it will be noticed that Mr. Anderson gives credit to Canda for taking an advanced position in the manufacture of ferro-alloys by electric furnace processes, particularly in the production of ferro-silicon and ferro-molybdenum.

Mr. Anderson points out that under normal conditions of the steel trade, and apart from what he terms the "outrageous" prices paid for ferro-alloys during the war period, which enabled plants to be profitably operated where power costs were high, the ferro-alloy industry will naturally centre around distributing points of cheap power, such as Niagara Falls, as it has done in France, Switzerland, Italy, Norway and Sweden.

The lack of sources of cheap hydro-power near the great steel centres of the United States is referred to by Mr. Anderson as a condition which cannot soon be overcome, and he concludes that ferro-alloy plants will continue to be located chiefly according to the relative weight of the following factors, namely: (1) Cost and availability of power; (2) Location of hydro-electric plants; (3) Distance to steel-making centres; (4) Location of high-grade ore supplies.

The application of these points to the Province of Ontario and to British Columbia should encourage faith in our own ferro-alloy industry, and should strengthen the courage of those persons who have already made it possible to record a production of ferro-alloys in Canada in 1919 of 47,000 tons, chiefly in Ontario.

A careful perusal of Mr. Anderson's paper by those who are interested in the Canadian ferro-alloy industry is recommended, particularly that part which refers to the necessity for protection of the domestic industry against cheap ores of foreign origin. This portion of the paper is not included in our abstract, as not being of general interest, but the analogies between the position of the United States' producer and his confreres in Canada is so close as to make it a source of valuable suggestion to those who have invested in ferro-alloy production on this side of the line. In some ores, the United States is self-supplying, notably in regard to molybdenum, and also vanadium, by reason of control of the Peruvian deposit at Minasragra by United States' capital.* In regard to manganese, chronium and tungsten, the position of the United States is not dissimilar to that of Canada. Wherever, of course, cheap electric power exists in close proximity to domestic mines of high-grade ores, ferro-alloys can be made without much fear of outside competition. There is encouragement in knowing that such a combination does exist in many parts of Canada.

* See "Iron and Steel," page 341, January 1920.

Iron Smelting in British Columbia---The Fleet Process

"Iron and Steel of Canada" has given much attention to the possibility of an iron and steel industry in British Columbia. It will be remembered that Dr. Stansfield, during his editorship, made a report for the British Columbia Government on the applicability of the electric furnace to the manufacture of pig-iron from the local magnetites. Because of Dr. Stansfield's insistence on the economic limitations of the electric process, and his statements that cheap electric power was a first necessity, his report has not been popular with persons whose enthusiasm has obscured their vision of these very real difficulties.

At the Western Meeting of the Canadian Mining Institute last November much time was devoted to discussion of the feasibility of iron and steel manufacture, and it was intimated that a serious attempt would shortly be made to commence the industry. Since that date the Provincial Government has taken powers to reserve iron-ore deposits to the Crown with a view to providing against the requirements of such a future development.

At the Institute meeting reference was made to the Fleet process of reducing magnetite to pig-iron by an adaptation of the accepted form of the electric fur-

nace, the chief novelty of which was an air-blast blowing into the furnace below the carbon electrodes. A description of this process appears in the "Mining Journal" (London, Eng.), and it contains so many departures from accepted electric-furnace practice that for the benefit of our British Columbia readers it is reproduced in this issue.

Nova Scotian readers will be surprised to know that the Sydney Steel Plant has been "courageously completely scrapped," but they will probably be even more surprised at the furnace which, differing from the usual method of protecting the carbons, "is furnished with a Root blower for supplying blast, "playing into the furnace to furnish oxygen for com- "bustion below the carbons." The use of the air blast to "freely circulate and disseminate the flow of 'juice' evenly throughout the whole charge in every part of the fusion zone" is we believe, quite a new feature.

The estimates of cost given in the article referred to cannot we think be maintained in practice. The cost of electric power is given at half a cent per kilowatt hour, a rate so cheap that we believe it is not obtainable. Hard coal, or coke, is estimated at $16 per ton. We doubt whether it could be obtained in British Columbia at double that price.

On the whole it does not appear that the Fleet process offers any solution of the difficulties of producing pig-iron or steel from local magnetites in British Columbia.

Some very encouraging results have however been obtained by the use of B. C. magnetites in electric furnace of accepted design on the Pacific Coast. At one plant, foundry pig-iron is being produced from B. C. ores direct, and a quantity in excess of 2,500 tons has already been produced at this plant.

There is every reason to look forward to an iron and steel industry in British Columbia commensurate to the local needs, and it is probable that both the electric furnace, and the ordinary coke-fired blast-furnace with open hearths adjacent, will be used as local facilities and requirements shall dictate, but such permanent industries will only come after careful calculation of the costs. Much of the necessary data is available, but much remains to be collated.

In the initial steps of reducing iron ores to the metallic form electric power is at a disadvantage when compared with fuel heat because of the large quantity of power required, and readers of our February issue will have noted that Dr. Stansfield in experimenting on a process which will reduce the ore to a metallic powder at moderate temperatures in fuel-fired furnaces, later melting this powder in electric furnaces for production of iron and steel. The Fleet process, so far as can be gathered, reverses Dr. Stansfield's experimental method, and undertakes to use electric heat first and fuel-heat later. We fail to follow the statement regarding the limitations of temperature in the blast furnace, nor is it quite apparent what the "melting point of magnetite" has to with a mixture of magnetite, limestone and charcoal.

Increased Wages to Mine Workers Cause Double Increase to the Ultimate Consumer

One of the least understandable contentions put before the public in connection with the selling price of coal is that it is possible for substantial wage increases to be given to the mineworkers without necessitating any increase in the price to the consumer. It has been suggested that an increase in wages at the source of coal supply can be minimised by larger production and economies until a vanishing point is reached with the arrival of the coal in the bins or cellar of the ultimate consumer. Nothing could be more misleading. The effect of a wage increase upon the selling price of coal must always be "crescendo" and never "diminuendo." One of the most unjust statements we have recently seen is a warning put out by a government official in the United States against profiteering in coal which intimates that the increased cost of coal to the consumer will be limited to the increased amount of wages given to the mine workers.

The mine-workers in the United States have been given an increase of 27 per cent in wages. To illustrate how this will work out, take as a concrete example a colliery raising 2,000 tons of coal per day, with a labour cost before the increase of one dollar per ton.

2,000 tons at one dollar	$2,000
Increase in wages of 27 per cent	540

As a result of the increased wages paid to the mineworkers there will be an immediate rise in the cost of materials secured locally, such as horse-feed, pit-timber, and in all incidental costs of hauling, machineshop work. This increase can be conservatively placed at five cents a ton. There will be a much greater ultimate increase, as eventually all the increased cost of wages will come back upon the purchase price of metal supplies, wire ropes, mine cars, oils, etc., but this rise will be gradual, and cannot be figured accurately as to immediate effect.

Added to the previously mentioned costs, we now obtain	$2,640.00
Divided by 2,000 tons, or, per ton	1.32

A colliery of this size will use for its own consumption, at boilers, for heating and yard transportation, say 200 tons daily. The extra cost of coal to fires will be therefore $64.00, being 2,000 tons at 32c per ton.

The price of coal to employees will remain constant, so that the increased cost must be recouped from an addition to the cost of production. Assuming the number of householders to be 125, which would be about right for a colliery of this extent, and consumption of coal at two tons monthly per household, there will be about ten tons daily, or say three dollars to be added to mine cost. The sum of these additions is $2,707.00, equal to a cost per ton of $1.35.

It is assumed that the production under increased wages will remain unimpaired, but it is well known that contract workers usually have before them a certain daily earning, which consciously, or unconsciously, they do not exceed. The history of wage increases has been that a decrease in the output of the contract worker follows. Should this be the case, the cost per ton will be increased by much more than the amount instanced.

The coal operators must charge the railways more for coal under these circumstances, which we will estimate will increase the cost of coal transportation to market by five cents per ton. As the wholesaler does business on a percentage basis, his spread on the handling of coal to the retailer will be necessarily increased by at least two cents per ton. The retailer, who must take a larger percentage, will probably have to add another five cents, and the teamster who deposits the coal in the cellar will be moderate if he does not add more than three cents per ton. Addition of these cumulative increases, all small, but we believe all unavoidable, will bring the original 27 cents per ton up to 50 cents, without any additional revenue to the coal operator.

Nothing is said of the case of the railways, who will shortly after the increase to the miners becomes effective, have to face a demand for increased wages from the railway employees, on the plea of dearer coal, and will also, as mentioned, have to pay more for locomotive coal.

The foregoing considerations have been confined to labour costs, but there are many other costs on the colliery sheet which will be affected by the wage increase, such as rates and taxes, insurance costs, compensation costs, and other fixed charges, and eventually every item of material, everything that depends on freight rates, administrative and executive charges, will be increased, too probably accompanied by a decreased production.

The foregoing is not intended as an example of the vicious circle, about which we have heard ad nauseum, but as concrete example of how a 27 per cent increase to the miner will, before it reaches the consumer, become a 50 per cent increase, despite all the pious hopes of the profiteer hunters, without benefiting anyone permanently, the miner himself not excluded.

There is no help for this condition of affairs apparently, but the officials of the United States Government should not add insult to injury by suggesting through the press that it is possible for coal operators to absorb the cost of wage increases out of their profits, or to confine the increase to the consumer to the actual amount of increase obtained by the miner. It cannot be done.

"Closed Shop" by Government Edict

The "Edmonton Bulletin" has the following:—

"Our so-called Minister of Labor has started to enforce his edict that no one may work in a mine in Alberta unless he belongs to the United Mine Workers. The first fruit of his enterprise in that direction is that four mining camps in the province are shut down, with more results of the same kind likely to follow the further extension of his mischievous interference. Autocratic measures can be carried a good way in Canada. But when it is attempted to compel men to join a labor union the point is reached where such measures ought to fail, and are likely to fail. Any man who can dig coal, and who is willing to do so, and to behave himself, ought to be allowed to work in a mine—so far as the law is concerned—without asking the consent of the United Mine Workers and Senator Robertson. And the people of Alberta are entitled to have coal to burn whether or not the men who dig it have the approval of this alien labor organization and the irresponsible head of the labor department. If the Minister of Labor cannot do anything to get men to labor he at least might stop preventing men from laboring at a time when increased production is so desperately needed."

In our January issue we expressed the belief that the enforcement of the "closed shop" by Government edict was new, and also very dangerous, because based on a fundamentally erroneous principle. The problem of the O.B.U. in the West was, and is, no doubt a very anxious one, but not even the most pressing problems can condone expediency, nor can it ever come about that the violation of a first principle of citizenship can ever bring in its train anything but harmful results. The Minister of Labour, or any other person in office, has no right to enforce membership in an organization upon any man. He might just as properly dictate the cut of his clothes.

The action of the Japanese in occupying Vladivostock, and the similar action of the French in the neutral area on the Rhine, indicates that there are at least two peoples in the world who know their own minds. The French are a very logical people, and the Japanese may be forgiven if they have been unable to follow the complexities of the Western mind in its chameleon-like attitude towards the Bolsheviki. They are also under the compulsion of living next door to these amiable people.

FRENCH RETALIATION FOR GERMAN SEIZURE AND DEMOLITION OF STEEL PLANTS IN FRANCE.

German Comment on the Sentence upon the Roechling Brothers.

The "Deutche Allegemeine Zeitung," a semi-official German daily, comments bitterly on the sentence of imprisonment, fine and exile imposed by a French court-martial on the Roechling Bros. of Volklingen and Diedenhofen. An excerpt from this comment, taken from a translation in the "Living Age" may not be without interest to our readers. The "Zeitung" says:—

> "Germany continues to discuss with indignation the sentence passed upon the Rochling Brothers by a French court-martial. They have been condemned to ten years in prison, fifteen years' exile, and a fine of ten million francs.
>
> "The facts of the case are very simple. As the war progressed, Germany found itself inexorably compelled to increase its output of war materials to the utmost in order to maintain itself against enemies who had the resources of the whole world at their call. Our army leaders, therefore, decided to make all the iron works in the occupied territories of service. With this in view the raw materials available at furnaces and iron works which were not in operation, were requisitioned, and their machinery was removed and placed at the disposition of German manufacturers at fixed prices in order to enable the latter to increase their production for the government. This was a harsh measure, but it was adopted under the compulsion of war and is a measure permitted by international law. The Rochling Brothers were engaged in carrying out this programme in the same way as other German industrial experts, and it is for this offence that they have been sentenced.
>
> "As representative of his establishment, Hermann Rochling negotiated with the German Government for the machinery to be obtained from stripping a French establishment, in order to enlarge his own plant at Diedenhofen. The military authorities desired him to make such extension, because his other works at Volklingen were not able to deliver war materials in required quantities on account of frequent aviation attacks. Robert Rochling is charged with having participated in carrying out this commission. He is further charged with having, in his capacity as an officer, participated in removing machinery from Belgian and French factories, not for his own works, but for other purposes.
>
> "Any unprejudiced judge will recognize from a mere statement of the facts that the conduct of these men was not punishable. So far as Robert Rochling acted in the capacity of an officer, he was merely carrying out orders. The only other acts charged against him were purchasing French machinery from the German Government, machinery which the German authorities could dispose of under international law. How does it happen, then, that a French court-martial will support a charge of theft and malicious damage under such circumstances? It was only accomplished by rejecting all legal forms and presenting a special plea to the effect that the Rochling Brothers had deliberately conspired to ruin French manufacturers in their own interest."

The French are probably not so concerned with the capacity of Rochling when he removed machinery from France and Belgium to his own steel works, as with the actual deed, which was designed, to use the "Allgeneine Zeitung's" own words, to ruin French manufacturers in his own interest. Military necessity can be pleaded in extenuation of every crime under Heaven, but it will never excuse the action of the Germans in destroying every industrial enterprise in the occupied zone of France, and the removal of the machinery to German factories. The Frenchman, is, above all men, noted for his clear and logical thinking, as the world has recently had occasion to observe.

CHANGE IN THE PRESIDENCY OF THE DOMINION STEEL CORPORATION

Roy M. Wolvin has been elected president of the Dominion Steel Corporation, Ltd., Sydney, N. S., to succeed Mark Workman, who resigned the position in order to devote his attention to personal affairs. Mr. Workman, however, has continued as chairman of the board of directors. He will become a member of the London advisory committee of the corporation at the instance of the British interests, who have become associated with it. After a rest at Atlantic City, he will sail for England.

Mr. Wolvin who has risen rapidly to a position of prominence in the industrial world, was born at St. Clair, Mich., Jan. 21, 1880. After a high school education in that city, he commenced his business career as clerk with the Western Transit Co., Duluth in 1896. remaining there about one year. He then became manager of the Great Lakes & St. Lawrence Transportation Co., and the Standard Steamship Co. and occupied these positions from 1901 until 1910. He next became president of the Standard Steamship Co., Winnepeg, Man., the Duluth Shipping Co., Duluth. and the Central Shipping Co., Chicago, in 1910. Later he became president of the Montreal Transportation Co., Ltd., Montreal, Que.; president of the Canada West Coast Navigation Co., Vancouver; vice-president and general managing director of the Halifax Shipyards, Ltd., Halifax, N. S.; president of the Canadian Towing & Wrecking Co., Fort William, Ont.; vice-president, Collingwood Shipping Co., Ltd.,; president, Reid Towing & Wrecking Co., Sarnia, Ont.; president of the Maritime Wrecking & Salvage Co., Halifax, and occupied other important and responsible positions. He was elected a director of the Dominion Steel Corporation in the middle of 1919.

Recent Developments in the Ferro-Alloy Industry

By ROBERT J. ANDERSON.*
Metallurgist, U.S. Bureau of Mines, Pittsburgh, Pa.

In dealing with progress in the metallurgy of the ferro-alloys, it would also be advisable ordinarily to deal with technical advances in the mining of metallurgical ores, concentration and chemical recovery, as well as developments in the metallurgy of ordinary and tool steels. Any attempt to do this would make the paper too long, but any cognate matter will be touched upon briefly. Recent progress in the metallurgy of the ferro-alloys has been characterized by some important departures from pre-war standard practice in this country, as well as by numerous technical and scientific investigations looking to the more economical manufacture and utilization of steel-making alloys. Much attention has been given to mining and concentration problems for the purpose of securing better recoveries and preventing waste, and these investigations should prove to be of substantial value to the industry and the country. The government technical and scientific investigations were confined principally to manganese, and tungsten to a lesser extent, but chromium, vanadium, and other metals would have been studied at length had the war lasted longer.

The ferro-alloy industry is relatively old, having been built up with the steel industry, but the significant metallurgical advances have come since 1899 with the employment of the electric furnace for the manufacture of all kinds of ferro-alloys. Ferro-manganese, spiegeleisen, and low-grade (Bessemer) ferro-silicon are still produced mainly in the blast furnace, but crucible practice for the manufacture of other principal ferro-alloys has vanished. At the present time, ferro-chromium, ferro-tungsten, ferro-titanium, ferro-molybdenum, and ferro-uranium are made principally in the electric furnace and a subordinate amount of some of these by the thermit process; ferro-vanadium is made largely by a modification of the thermit process in an open-hearth furnace, but the electric furnace has been gaining ground for ferro-vanadium reduction. The electric-furnace manufacture of ferro-silicon has grown to large proportions, and this alloy is made in all grades in the electric furnace. Generally speaking, the thermit alloys are higher in price than electric-furnace alloys, and they are subject to the market fluctuations in the price of aluminum while the latter are not. Metallurgical progress and tendencies are discussed briefly below for each individual alloy.

Ferro-Manganese and Spiegeleisen.—A great deal of attention was given to manganese during the war, and several metallurgical changes in practice were put into effect. The standard contents of ferro-manganese (78-82 per cent) and of spiegeleisen (18-22 per cent) were lowered to 70 and 16 per cent manganese respectively, so as to make practical the utilization of lean domestic ores, and to conserve manganese. At the same time, two other alloys, silico-manganese and silico-spiegel came into some prominence. In the conservation efforts carried out during the war, it was shown that the lower grades of ferro-manganese and spiegeleisen could be satisfactorily employed in steel making, but the personal prejudice of most steel makers is against such alloys; immediately after the restrictions were removed at the close of the war, production of the lower grade alloys ceased, and the former standard grades are now made exclusively. Efforts were also made to substitute spiegeleisen for ferro-manganese for the higher carbon steels; this was not a metallurgical advance, but rather a retrogression to the practice of the Bessemer rail mills, using cupolas to melt the spiegeleisen. An investigation carried out with the idea of conserving manganese in open-hearth practice and utilizing alloys other than ferro-manganese, pointed out metallurgical advances in three directions, viz. (1) the use of a molten spiegel mixture for deoxidation and recarburization; (2) the practice of melting and refining the steel bath so as to insure a relatively high residual content of manganese; and (3) the use of manganese alloys containing silicon (silico-manganese). As has been mentioned, the use of silico-manganese and silico-spiegel was extended somewhat. Difficulty in obtaining sufficient supplies of ore suitable for the production of ferro-manganese led to active consideration and large scale experiments in the smelting of manganese-lean and siliceous ores in the electric furnace for making so-called intermediate alloys such as the following:

Approximate Chemical Composition, Percent.

Alloy.	Mn.	Fe.	Si.	C.
Silico-manganese	55-70	20-5	25	0.35
Silico-spiegel	20-50	67-43	4-10	1.5-3.5

Alloys like the above can be made readily in the electric furnace, but the extent to which they can be employed depends largely upon the prejudice of the American steel maker rather than upon metallurgical considerations. It has been demonstrated, however, that large tonnages of silico-manganese can be used in the United States in the manufacture of steels to which both ferro-manganese and ferro-silicon must normally be added, and sufficient evidence is at hand (based on foreign practice as well as large scale experiments in this country) to indicate that the use of silico-manganese is metallurgically sound and desirable. Prior to the war, practically all the ferro-manganese made in the United States and elsewhere was a blast-furnace product, and a metallurgical development of importance has been the commercial electric-furnace manufacture of this alloy. No spiegeleisen has been made in the electric furnace as a commercial alloy, and the entire output is made in the blast furnace. Scarcity of ferro-manganese, high prices of coke, and shortage of ores made it profitable for a number of electric-furnace plants to be built for the production of ferro-manganese, and it was generally found advantageous to build them near manganese mines, even in the face of high power costs.

During the period when the electric-furnace ferro-manganese plants were developed in the United States, many of the difficulties incident to reduction of the alloy were overcome, but metallurgical progress is still possible in several directions, viz., as to size of units,

*A paper presented at the Boston Meeting of the American Electrochemical Society, April 8-10, 1920. Abstracted.

voltage to be employed, and reduction of losses by dusting and in the slag. Any decided metallurgical progress in ferro-manganese smelting by the electric furnace is doubtful, for it is problematical whether any more than a very few of the more advantageously situated plants can continue operations under present conditions. Both fuel and manganese losses in the blast-furnace production of ferro-manganese are normally high, manganese losses varying from 15 to 25 per cent in the slag, whereas in electric-furnace practice this loss has been brought down to 10 per cent. Until the latter practice becomes more firmly established, metallurgical developments of signal importance can be readily effected in blast-furnace practice, notably by the use of low-ash coke and low-silica stone, and large savings can be made by adherence to metallurgical principles in the operation of manganese-alloy stacks.

Manganese recovery in the manufacture of silico-manganese by the electric furnace is, however, normally quite high (about 95 per cent) because of the absence of slag, and the direct manufacture of silico-manganese is a marked advance over the earlier method employed of mixing molten ferro-manganese and ferro-silicon to form the desired alloy. Ordinarily, blast furnaces making ferro-manganese can operate economically on ores containing not much less than 40 per cent (or 35 per cent at least) Mn, nor more than 12 per cent Si, but the electric smelting of both low-grade domestic ores and manganiferous slags has been shown to be metallurgically feasible; it is scarcely profitable to attempt to so smelt such ores in normal times and prices.

The Jones (direct reduction) process for the concentration of manganese in manganiferous iron ores, where the association of the manganese and iron is so intimate that the ordinary gravity or magnetic-separation methods fail, has been shown to be metallurgically sound, but its possibilities under normal conditions in the ferro-manganese industry are not yet proved. Looking back over the metallurgical developments of the past five years in ferro-manganese and related alloys, it is seen that numerous investigations have pointed the way to advanced practice, and, although some of the experiments made have not been demonstrated commercially under normal conditions, the general progress has been of significant importance. It is unfortunate that the same cannot be said of some of the other alloys which, metallurgically, stand in about the same position as they did ten years ago.

Ferro-Silicons. — From the standpoint of tonnage produced, ferro-silicon is the most extensively used of all the ferro-alloys made in the electric furnace. Blast-furnace ferro-silicon, so-called Bessemer grade, had been manufactured for many years in the United States, but there were only one or two producers of 50 per cent electric-furnace ferro-silicon in this country prior to 1914. Owing to the large demand in the steel industry, the number of producers was increased to about 15 in 1918, but during the period of liquidation and collapse in 1919 a number of the plants have been dismantled and junked.

The main reason for the slow development of electric-furnace manufacture of ferro-silicon in the United States had been the cost of power; power consumption is normally very heavy, and although the cost of raw materials is low, it had previously been found cheaper to import 50 per cent alloy, as well as the higher grades. Steadily increasing open-hearth capacity prior to the war caused a regular increased consumption of 50 per cent ferro-silicon, but this was not reflected in further expansion of the domestic output to any extent.

High Silicon Steel for Shells Caused demand for Ferro-Silicon During War

The great expansion in the domestic output of ferro-silicons of all grades, as well as that of Canada, England and France, was the result of the enormous quantities of shell and munitions steel made; these steels run fairly high in silicon, considerably higher than ordinary structural steels, and large amounts of ferro-silicon were required.

A number of new electric-furnace plants were installed during the period 1914-1918, most of the expansion coming during the first three years of the war, with Canada taking an advanced position. The higher grades of ferro-silicon, containing 75 and 90 per cent Si, found increased application in the manufacture of high-silicon electrical steels, and the manufacture of these alloys was undertaken by steel companies for their own consumption.

No important metallurgical advances have taken place in blast-furnace ferro-silicon practice, but the production of low-grade ferro-silicon (10-15 per cent Si) in the electric furnace is worthy of note. Whether the electric-furnace producers of low-grade ferro-silicon can compete with the blast-furnace makers is somewhat conjectural, but the former have made a determined attempt in 1919 to establish themselves in this field. Only the lowest grades of ferro-silicon can be made in the blast furnace because of the difficulty of reducing silica, and all the higher grades must be made in the electric furnace; there have been some attempts, however, to produce 50 per cent ferro-silicon in the blast furnace by using a blast enriched with oxygen.

The over-expansion of electric-furnace capacity for ferro-silicon during the war period was markedly shown by the collapse in 1919. Although ferro-silicon is normally produced in electric furnaces only in localities where power is cheap, under the conditions brought about by the war, the higher grade alloys were manufactured profitably even where power is relatively dear, for example at Baltimore, Md., near Pittsburgh, Pa., and at Anniston, Alabama.

Ferro-Chromium.—This alloy, usually and erroneously called ferro-chrome, is an electric-furnace product almost exclusively; a carbon-free grade is made by the thermit process. Prior to the introduction of the electric furnace for ferro-alloy manufacture, practically all ferro-chromium was made in the blast furnace; a small amount was made in the crucible. Only low-tenor ferro-chromium can be made in the blast furnace, and then, for alloys containing about 40 per cent Cr., rich ores, high temperatures, and high blast pressures are required; coke consumption is also normally excessive. The older methods have been practically superseded because of the distinct advantages offered by the electric furnace, but the demand of the steel makers for high-tenor ferro-chromium low in carbon have been an additional incentive to electric-furnace manufacture.

There were only two domestic makers of ferro-chromium prior to the war, but the number of producers in 1918 was about ten, and the capacity was about 25,000 tons per annum. The situation in ferro-

chromium has been somewhat analogous to that in ferro-tungsten, but the metallurgical advances in ferro-chromium have been more noteworthy in the past five years. Metallurgical progress has been made in the direct production of low-carbon ferro-chromium in the electric furnace, in the refining of high-carbon alloys, and in smelting lean domestic ores. Keeney's notable experiments on the smelting of low-grade ores and chromium slags have contributed materially to recent metallurgical progress. It has now been shown that good recoveries of chromium may be expected when smelting lean ores provided the carbon in the resultant alloy is allowed to run high enough (7 per cent); from a metallurgical standpoint, entirely satisfactory results have been obtained from high-grade domestic ores in smelting all grades of ferro-chromium.

During the war, most of the ferro-chromium used in the steel industry was for the manufacture of chromium-nickel and chromium-vanadium steels, either directly or indirectly for government requirements, but with the withdrawal of the war-demand some of the new companies, which made ferro-chromium, have been forced to suspend operations temporarily or completely. The alloy containing 6-8 per cent C and 60-70 per cent Cr is a standard grade, but some steel makers prefer high-tenor alloys with less carbon. The metallurgical difficulties in making a low-carbon alloy require further investigation, for at the present time the cost of additional refining makes the cost of low-carbon alloys several times as much as high-carbon ones.

Ferro-Tungsten.—Prior to 1914, nearly all of the tungsten powder and ferro-tungsten used in the United States for the manufacture of high-speed steel was imported from Germany, but during the war the United States became a large producer and exporter of ferro-tungsten and metallic tungsten. The metallurgical importance of tungsten is due practically entirely to its use in the manufacture of high-speed steel, and about 95 per cent of all the tungsten (whether as concentrates, ferro-tungsten, or tungsten powder) produced or imported, ultimately finds its way into special steels. Some people entertain the idea that much tungsten is employed in tungsten-lamp manufacture, but the amount used for that purpose is infinitesimal compared to the total quantity consumed.

The growth of the manufacture of ferro-tungsten and tungsten powder in the United States is best shown by the following: prior to 1914, practically no ferro-tungsten was made here, although at the same time Germany was importing ores from this country and shipping ferro-tungsten for American consumption. At the close of 1918, there were about 20 domestic makers of ferro-tungsten and tungsten powder, but some of these have been obliged to cease operations in 1919. Normal consumption of 60 per cent WO_3 concentrates for the manufacture of ferro-tungsten and tungsten powder is now rated at about 7,500 tons per annum, by a leading maker.

Naturally, during the war the demand for tungsten for high-speed steel to be used in machining shells, munitions, and machinery was enormous, but in normal times the demand had expanded heavily with the development of the automobile. A further increased demand is looked for in connection with tractor development, which promises to be very large, and the demand for high-speed steel is certain to advance. The metallurgical advances in the manufacture of ferro-tungsten have been few in recent years, and the main technical progress in the tungsten industry of the United States has been in connection with milling and concentration; at the height of the tungsten-ore production, the milling of ores in Boulder, Colo, district had reached the highest development anywhere in the world.

Formerly, tungsten powder was used almost entirely for fixed additions to steel, but the powder has now been replaced to a considerable extent by low-carbon 80 per cent ferro-tungsten. At the present time, in the manufacture of high-speed steel about 50 per cent of the tungsten used is in the form of ferro-tungsten, the remainder being tungsten powder. Metallurgically, there should be no particular advantage in either, but if the ferro-tungsten is not homogeneous variations in the tungsten content of the steel may occur. On the other hand, loss by oxidation in making fixed additions to steel are claimed to be less when ferro-tungsten is employed than tungsten powder. The use of ferro-tungsten is growing in favor. No serious difficulties are met with in the reduction of ferro-tungsten in the electric furnace; it is one of the easiest alloys to reduce and does not so readily oxidize or form carbides as chromium and uranium. No progress has been made in tapping high-grade ferro-tungsten from the electric-furnace, and the alloy is still made principally in knock-down furnaces. Lower grade ferro-tungsten can be tapped, but it is not practice to do so. The ability of domestic makers to turn out a high-tenor, uniform, ferro-tungsten has been demonstrated, and the use of tungsten powder is likely to decrease, more ferro-tungsten being made from year to year. Some ferro-tunsten is still made by the reduction of tungsten concentrates in the crucible with carbon, but the bulk of the output in the United States is made in the electric furnace by reduction with coke or other form of carbon.

Ferro-Vanadium.—About 75 per cent of ferro-vanadium made in the United States is manufactured by the thermit process, or by a modification of the thermit process in the open-hearth furnace using metallic aluminum as the reducing agent. The remainder of the ferro-vanadium is made in the electric furnace using 90 per cent silicon as the reducing agent. Consequently, the price of ferro-vanadium is affected largely by the fluctuations in the aluminum market and to a less extent by the price of silicon. Reduction of vanadium oxide or vanadate of iron by carbon in the electric furnace has been generally abandoned because of the difficulty in holding carbon low in the resultant ferro-vanadium, and this element is highly objectionable to steel makers.

Metallurgical advances in ferro-vanadium as to the thermit reduction of the alloy have been almost at a standstill, and the main technical advances have come in the chemical processes for extraction of vanadium from domestic ores, particularly the Colorado camotite, in the development of vanadium steels for castings and forgings, and in the use of vanadium in high-speed steels. The 33 per cent ferro-vanadium has been shown to be the most suitable for use in the metallurgy of steel. Silicon metal has been found to be the most satisfactory reducing agent for electric-furnace practice, but high-grade ferro-silicon can also be used. Metallurgical progress has been made in the refining of high silicon ferro-vanadium so as to obtain a product containing less than 1 per cent Si, and

it is much easier to reduce the silicon content of ferro vanadium by refining than the carbon content of the same alloy made by reduction with carbon.

In connection with the recent reorganization of the American Vanadium Co., plans called for an electric-furnace installation for working over the large slag dumps at Bridgeville, Pa., for the purpose of recovering the vanadium lost by the earlier operations. Additional progress has been made in metallurgical investigations looking to the utilization of domestic ores, particularly the vanadinites and complex ores of New Mexico and Arizona. With the threatened decline in the output of the Peruvian mines, the domestic vanadium-bearing minerals of little importance at present may become commercial ores of vanadium.

A noteworthy change in recent years has been the introduction of vanadium into high-speed steels, particularly all high tungsten-chromium and molybdenum-chromium steels. The growth of the ferro-vanadium branch of the ferro-alloy industry in this country has not been so marked in the last five years as was the case with ferro-silicon, ferro-tungsten, and ferro-chromium; however, the United States was the largest maker of ferro-vanadium both before and during the war, and the domestic output increased considerably during the war period. There were two or three domestic producers of ferro-vanadium prior to 1914 and six or seven at the close of 1918.

Ferro-Titanium Alloys.—Alloys of iron and titanium were developed for use in the metallurgy of steel after the introduction of the electric furnace, and at the present time the greater part of the ferro-titanium made in the United States is an electric-furnace product. Some carbon-free ferro-titanium is made by the thermit process, but this alloy also contains varying amounts of aluminum. There are still two distinct kinds of ferro-titanium alloys manufactured, one called ferrocarbon-titanium, containing 15-18 per cent Ti and about 6 per cent C, and the other a carbon-free product, containing about 25 per cent Ti. The former is made in the electric furnace and the latter by the thermit process.

The use of titanium-treated rails fell off markedly for several years prior to 1914 because of the ascendency of the open-hearth process in making rail steel; consequently with the decline of Bessemer tonnage of rails, the amount of ferro-titanium alloys used in their manufacture decreased rapidly. This followed because it was thought that the supposed superiority of the open-hearth rail would obviate the use of titanium in rail steel, but further experience indicated that the use of ferro-titanium alloys was also desirable for open-hearth rail and other steels, so that titanium is again used in large amounts for scavenging steel. About 2,500,000 tons of steel were treated with ferro-titanium alloys in 1918, and the metallurgical value of additions of titanium has been shown to be of distinct importance in treating all kinds of steels.

During the war in connection with conservation of manganese, numerous experiments were carried out for the purpose of substituting ferro-titanium alloys for ferro-manganese either in whole or in part; partial substitution of ferro-titanium for ferro-manganese has been successfully effected, and this practice will probably continue to increase in view of the results obtained on a large scale! One steel plant has been able to reduce the usual amount of ferro-manganese about 50 per cent by addition of ferro-titanium in the ladle. No important metallurgical advances in the smelting of ferro-titanium have occurred, and although numerous patents have been taken out in recent years for metallurgical improvements and new methods, the recent progress has been largely the result of gradual betterments in previously existing practice. Exports of ferro-titanium alloys have continued to grow, and the United States continues to occupy a leading position in the titanium branch of the ferro-alloy industry.

Ferro-Molybdenum.—This alloy has suffered some peculiar vicissitudes in fortune from the metallurgical standpoint, and an exceedingly large amount of contradictory information has been issued in regard to the value and properties of molybdenum steels. However, the employment of molybdenum in the metallurgy of steel is admittedly in its infancy, and too much cannot be logically expected at the present time. Prior to 1914, only about 10 ton of ferro-molybdenum was made annually in the United States and that almost entirely for export. Ferro-molybdenum is now generally made in the electric furnace directly from raw molybdenite (MoS^2) concentrates, although it was formerly made by the reduction of the roasted sulphide in the crucible with carbon as the reducing agent. At the present time, the use of roasted ore has passed, and the molybdenum-bearing material for reduction with ferro-molybdenum may be raw molybdenite concentrate, or a sodium molybdate (Na_2MoO_4) slag obtained from wulfenite.

Canada Produced Large Quantities of Ferro-Molybdenum During War

Experimental runs have been made in Canada with pure molybdic acid. In the electric furnace either carbon or silicon metal is used as the reducing agent; the former is more generally employed, and the use of silicon (and ferro-silicon for the production of the lower grades of ferro-molybdenum) is a recent commercial departure although covered by early patents. In 1918, several hundred tons of ferro-molybdenum were produced in the United States, largely for export, and during the war period Canada became a large producer of the alloy. Even yet, because of the infancy of the industry, standard grades of ferro-molybdenum are not well established, but alloys are offered containing from 50 to 80 per cent Mo and 1 to 3 per cent C. As in the case of ferro-tungsten and ferro-chromium, metallurgical advances in the smelting of ferro-molybdenum have not been marked in recent years, and the technical developments in the molybdenum industry have come largely in the concentration of molybdenite by flotation and in the development of molybdenum steels. Molybdenite concentration had reached a high state of development in the United States and Canada in 1918, but the collapse of the molybdenum market has compelled domestic mines and mills to suspend operations.

The development of molybdenum steels has been the result of European investigations principally, and further application of these steels is looked for. Considerable furore has been raised recently over the molybdenum steel developed by Dr. Arnold in England, but this development, in fact, dates back to 1899 and essentially calls for the use of vanadium and the substitution of molybdenum for tungsten. Much of the actual development in molybdenum steels during the war was closely connected with ordnance matters both here and abroad, and the results of experiments are just now coming out. Among other things, the de-

velopment of complex molybdenum steels for forgings is noted, as well as the use of calcium molybdate for making fixed additions of molybdenum to steels. There is an ample supply of workable ore in the United States; notably the deposit at Climax Colo., and this country should have no difficulty in supplying its own internal requirements of ferro-molybdenum. In the past there has been doubt as to whether supplies of ore would be advisable,but with that doubt definitely set out of the way, the expansion of the domestic ferro-molybdenum industry rests solely on the future of molybdenum steels.

Ferro-Uranium.—This is one of the more recent ferro-alloys to be suggested and used in the metallurgy of steel, particularly for fixed additions in the manufacture of so-called uranium tool steels. All of the ferro-uranium made in the United States for commercial sale is obtained by reduction of by-products derived from the carnotite ores of Colorado, secured principally by the method of extraction employed by the National Radium Institute. The important metallurgical advances in ferro-uranium and uranium steels have dated from the original work of the Bureau of Mines in co-operation with the Institute and a private steel company; ferro-uranium was developed principally to secure an outlet for the large amounts of sodium uranate, $Na_2U_2O_7$, which accumulated as a by-product from radium production. Sodium uranate is converted into the black oxide of unranium by reduction with carbonaceous material on fusion with sodium-chloride, and the resulting uranium oxide, UO_2, is the raw material for the electric-furnace production of ferro-uranium.

The general method developed for the manufacture of ferro-uranium of varying grades is by reduction of uranium oxide with carbon in a tilting electric furnace; ferro-uranium cannot be economically made by the use of silicon metal as a reducing agent because the recovery is low and the silicon content of the resulting alloy too high. It has been shown that ferro-uranium containing from 40 to 70 per cent U and about 2 per cent can be made commercially, without a second refining operation, under certain conditions, and refining for lowering carbon in the case of ferro-uranium is undesirable because of the tendency of the alloy to lose uranium by oxidation into the slag. From the metallurgical standpoint it is difficult to make a low-carbon ferro-uranium simply by regulating the amount of carbon charged, as is the case with some of the ferro-alloys.

Some further experiments have been made in recent years on the production of metallic uranium, as well as in the case of metallic uranium for fixed additions to steel. Metallic uranium (containing considerable uranium carbide) has been made by the reduction of uranium oxide with petroleum coke in a stationary electric furnace, but the direct recovery of uranium is low. Furthermore, uranium metal is not satisfactory as ferro-uranium for making fixed additions to steel because of its high melting point and ease of oxidation. Ferro-uranium has been shown to be more suitable, and the grade containing about 25 to 35 per cent U is satisfactory when less than 2 per cent U is required in the resultant steel.

Minor and Complex Ferro-Alloys.—Numerous alloys of iron with our elements have been suggested and used in the metallurgy of steel for various purposes, including ferro-aluminum, ferro-boron, ferro-cerium, ferro-cobalt, ferro-nickel, ferro-phosphorus, ferro-tantalum, ferro-zinc, ferro-zirconium, ferro-silico-aluminum, ferro-manganese-aluminum, ferro-silico-alumianese-aluminum, ferro-calcium-silicide, ferro-titanium-aluminum-silicide, and some others. Ferro-aluminum is not being made but an important metallurgical possibility for its manufacture from ferruginous oauxite in the electric furnace is suggested by Richards. It was formerly made as a regular alloy for the final deoxidation of steel, but its use ceased when commercial aluminum became relatively inexpensive. As an electric furnace alloy made from bauxite, it probably can be made to sell at a less relative cost than aluminum.

The electric-furnace work to date on ferro-boron has been largely experimental, i. e., ferro-boron has been made for determining the effect of additions of boron eo steel, but no alloy maker in the United States has yet undertaken its manufacture on a commercial scale. The alloy is made in the electric furnace by the direct reduction of colemanite with iron ore and carbon. Ferro-Cerium is one of the newest of the ferro-alloys; it is made by the direct alloying of iron with misch-metal (50-60 per cent Ce, 25 per cent La, 15 per cent Di, Sa, etc., and 1-2 per cent Fe), and the ordinary ferro-cerium contains 30 per cent Fe and 70 per cent misch-metal.

Considerable experimental work has been carried out in cerium steels during the past five years, but the results of the majority of these investigations have not been made public. Ferro-cerium has recently been employed as a deoxidizer for cast iron,[25] where it has been found to increase the tranverse strength and deflection. Its deoxidizing action is excellent because of the high heats of oxidation of the cerium-group metals.

Use of Cobalt Metal in Tool Steels

Ferro-cobalt is not made any longer, so far as is known, but a number of patents pertaining to complex ferro-cobalts and other cobalt alloys have been secured. Cobalt metal is preferred to ferro-cobalt for making fixed additions in the manufacture of cobalt-bearing tool steels, but the use of cobalt in these steels is declining.

Ferro-nickel is seldom made in the electric furnace, but usually by the direct alloying of iron and nickel in the desired proportions; however, nickel is added to steel, usually as metallic nickel rather than ferro-nickel Ferro-phosphorus is an important steel-making alloy, but the tonnage consumed is not large; it is employed for making fixed additions of phosphorus in the open-hearth in the manufacture of sheet steels.

Ferro-phosphorus is made in the United States in the electric furnace and in the blast furnace, by reduction of apatite and phosphate rock, and the electric furnace manufacture of this alloy in connection with the fertilizer industry is a development which occurred during the war period. Domestic consumption of ferro-phosphorus has been steadily increasing because of the increased demand for automobile sheets, and the electric-furnace manufacture of the alloy has been undertaken by several companies in the United States in the past few years. Ferro-zirconium is one of the newest of the ferro-alloys; it is used for the manufacture of special zirconium steels. The alloy has been made by the thermit process, but its regular manufacture has not been undertaken commercially in the United States.

Further interest has been shown in ferro-silico-aluminum during the past two years, and experiments on the use of the alloy as a deoxidizer for steel are now being carried out; it has been recently made in the electric furnace at Baltimore, Md. A large number of patents have been secured for the preparation of numerous complex ferro-alloys, but most of these alloys have not been applied on a working scale in the metallurgy of steel.

Electric Power and the Location of Ferro-Alloy Plants.—The cost and availability of electric power for electro-metallurgical work is a determining factor in the location of ferro-alloy plants as well as in the choice of process employed for some alloys. The domestic ferro-alloy industry has been centered for years near sources of relatively cheap power, viz., Niagara Falls and the Pacific coast, largely in the former place, but with the advent of outrageous prices during the war it was profitable to operate plants at points where the power was relatively costly and far removed from the steel-making centers. Foreign ferro-alloy progress has largely followed the hydro-electric developments in France, Switzerland, Italy, Norway and Sweden, and the domestic ferro-alloy industry did not expand at the same rate as the foreign industry prior to the war because of lack of cheap power and the remoteness of cheap power where it might have been made available. This is a condition which will not be soon overcome in the United States, and ferro-alloy plants will continue to be located chiefly according to the relative weight of these factors; (1) cost and availability of power; (2) location of hydro-electric plant; (3) distance to steel-making centers; (4- location of high-grade ore supplies. The first three factors are the predominating ones under normal conditions, but emergencies such as a war can radically upset accepted practice. Thus, with prices sufficiently high, it has been profitable to use relatively costly electric power for the manufacture of ferro-manganese rather than to employ the blast furnace and coke as a fuel; high prices and heavy demand coupled with high prices made the electric-furnace manufacture of ferro-manganese economically possible even in districts remote from the ferro-manganese markets.

BELCHER ISLANDS IRON-ORE DEPOSITS.

A party recently left Toronto to further explore the iron-ore deposits of Belcher's Island in Hudson Bay. The party is to travel by flat boat and motor launch over 300 miles up the coast of James and Hudson Bays. To get there the cargo of boats and provisions will go to Cochrane and from there to Pagwa, where the boats take the water to the Pagwatchewan River and commence their journey of about 300 miles to Moose Factory on James Bay, and thence around the bay and 300 miles up the coast. The two making the trip are E. E. LaDuke and his partner Samuel Salisbury. They expect to be away on the trip about a year.

Mr. James McEvoy of Toronto visited the Belcher Islands last Autumn and on his return gave out an interesting account of the mineral-bearing possibilities of this difficult region. (See page 309, December issue "Iron and Steel of Canada.")

IMPORTANT CONSOLIDATION OF BRITISH FIRMS FOR THE PRODUCTION OF BENZOL AS A MOTOR SPIRIT.

Suggests Similar Possibilities for Increased Production and Popularization of Benzol Motor Spirit in Canada

Under the name of Benzol and By-Products, Limited, a company is being formed in England to manufacture benzol and place it upon the market as a motor spirit. The capital of the new incorporation is set at £700,000, and will be used, among other things to acquire the plant of the Crigglestone Colliery Coke-Oven and By-Product Works and the Mitcham Benzol Refinery, which now has an annual output of one million gallons of standard motor spirit.

Refined benzol is now well-know as an ideal motor spirit, but its production on an economic basis has hitherto been hampered by the fact that refiners have been in a position only to obtain the crude benzol on terms which prevented competition with petrol. The new company will undertake all the processes of manufacture, from the mining and coking of the coal to the final sale of refined motor spirit, and in this manner it is expected to undersell petrol.

In Canada, there are number of steel incorporations producing crude benzol from coke-ovens, for which crude benzol they are not obtaining the most advantageous prices. Actual experiment with these coke-oven benzols in Canada have proved their suitability, in connection with which reference may be made to an article on the use of benzol and benzol mixtures as a motor fuel, by Mr. I. C. Mackie, Chief Chemist and Metallurgist of the Dominion Steel Corporation, which was published in this periodical in the September issue. (See page 221, issue September 1919.)

During the war, the extraction of benzol was undertaken in Canada on a greatly enlarged scale, primarily for the production of toluol, and now that toluol is no longer required for the manufacture of explosives, a market is desired for the benzol. Seeing that the market for motor cars is apparently unlimited, and that, as the Boston News Bureau points out, no manufacturer of motors has up to now proved the existence of a saturation point for motor sales, and seeing also that the supply of motor spirit refined from crude petroleum is not keeping pace with the demand, and that there are ominous signs of oil shortage, it would seem that the market for a benzol spirit, ready for use by the motorist, affords opportunities for profitable exploitation.

A combination of the coke-oven operators of Canada to produce and refine crude benzol primarily for use as a motor spirit would appear to be a logical possibility of existing conditions, and one that would afford greater profits and a steadier and larger market for crude benzol that is now at the disposal of the steel companies. The control by the Canadian steel companies of collieries and coke-ovens places them in a position of relatively much greater advantage for the production of moderately priced motor-spirit than the English incorporation referred to, and the bituminous coals of Nova Scotia are in particular extremely well adapted for the production of light oils and all other by-products of coke-oven coal distillation.—F.W.G.

Report of Operations of Steel Company of Canada in 1919

A Performance of Remarkable Merit.

The annual report to the shareholders of the Steel Company of Canada for 1919 must be very gratifying to the shareholders, as, under the circumstances prevailing in the steel trade during the first six months of 1919, the financial success of the Company's operations is so pronounced as to be little less than astonishing. The year 1919 was an unsatisfactory and makeshift year at its best, so that the Steel Company's success under such conditions foreshadows an excellent year in 1920 should existing conditions of demand persist, as they seem likely to.

Coming upon the heels of the Report of the Nova Scotia Steel Company for 1919, which reflected the pronounced depression of iron and steel demand in Nova Scotia during the first seven months of 1919, and was because of the substantial earnings achieved in spite of the depression, also a very satisfactory record of operations; the Steel Company of Canada's Report bears testimony to the present importance of our steel industry in providing employment in Canada on a large scale, and to the very necessary part in the country's development towards self-sustenance played by the steel enterprises.

The Profit and Loss account in each of the last three years is shown compared in the following table:

	1919.	1918.	1917.
Gross profits.	$4,000,940	$5,367,120	$6,040,318
Written off	....	1,434,450	1,806,486
Balance	4,000,940	3,932,669	4,233,832
Sinking fund	192,730	185,052	177,531
Balance	3,808,209	3,747,617	4,056,301
Depreciation	911,133	802,687	806,000
Balance.	2,897,075	2,944,930	3,250,301
Bond interest	514,904	515,171	515,203
Balance.	2,382,171	2,429,758	2,735,098
Pref. Divs.	454,741	454,741	454,741
Balance.	1,927,430	1,975,017	2,280,356
Com. divs.	805,000	690,000	690,000
Balance.	1,122,430	1,285,017	1,590,356
Fire res.	50,000	60,000	40,000
Balance.	1,072,430	1,225,017	1,550,356
Pension F..	200,000	100,000	....
Surplus	872,430	1,125,017	1,550,356
Previous balance	7,322,872	6,197,854	4,647,497
P. & L. Balance	8,195,302	7,322,872	6,197,854

A new and commendable item in the 1919 liabilities is $305,000 for "Pension Fund." This is a hopeful sign in more ways than one. It not only shows an interest in the company's servants by the President and Board, but it also indicates a length of service and a general stability in the company's affairs that makes for efficient team-work within the organization, and has no doubt a great deal to do with the very satisfactory Report of the company.

The Balance Sheet for 1919 compares with 1918 as follows:

Assets.

	1919.	1918.
Properties	$27,382,151	$26,932,703
Investments	3,734,545	2,276,868
Sinking fund	39	31
Adv. subsidiaries.	687,652	314,106
Inventories	5,503,833	6,691,929
Accounts rec.	4,310,211	5,085,467
Bills rec.	21,736	130,238
Cash	2,076,403	805,828
Other securities.	2,884,209	3,214,893
Special purposes	1,037,147	189,369
Deferred charges	22,457	11,391
Totals	$47,660,389	$45,652,831

Liabilities.

	1919.	1918.
Bonds	$8,562,225	$8,751,246
Notes.	30,000	180,000
Preferred stock	6,496,300	6,496,300
Common stock	11,500,000	11,500,000
Accounts and bills payable	3,187,270	3,410,629
Unclaimed dividends	10,344	9,339
Dividends payable	401,185	286,185
Reserves, etc.	3,725,753	3,553,358
Sinking fund	809,267	616,537
Pension F.	305,245	....
Depreciation	4,437,495	3,526,362
Surplus	8,195,302	7,322,872
Totals	$47,660,389	$45,652,831

Quick assets, less current liabilities, show a working capital of over eleven million dollars.

Investments, which include coal and ore properties, show an addition during the year of about $1,500,000, and an increase of over $800,000 is recorded in the Special Purposes Account.

After allowing for sinking funds, a very substantial amount for depreciation, bond and preferred interest, the amount available for common stock dividends is equivalent to 16¾ per cent on the common stock, which compares with 17.18 per cent for 1918 and 19.8 per cent for 1917. Such a rate of earning, when the unusual nature of the years 1917 and 1918 is considered, is not less than remarkable, and shows a quick adaptation of equipment to peace time requirements. It is also no doubt largely a result of the variety of products which the company's equipment enables it to manufacture.

The report would also indicate that the nearness of the Steel Company of Canada's plants to the domestic markets, the versatility of its manufacturing equipment, and the rapidity with which advantage can be taken of quick changes in demand and prices for varying products, offset the comparative advantages possessed by the steel companies in Nova Scotia through control of coal and iron supplies in close proximity on the seaboard.

COMPANY NOTES

DOMINION STEEL COMPANY TO BLOW IN ANOTHER FURNACE

The No. 4 blast-furnace at the Sydney Plant is being restarted, after having being idle since the middle of 1919. While no large new orders have been received, sufficient orders of medium size have been received to require an additional furnace.

MIDLAND COMPANY CLOSES DOWN.

The Midland Shipbuilding Company has temporarily closed its plant owing to difficulties in getting supplies of steel for construction work. The Company has been struggling with adverse conditions in the matter of deliveries of ship plates. Two ships are under construction at the present time and work on these will necessarily be held up for a time until steel begins to come through more freely.

Volta Company Re-organized.

To acquire and take over the undertakings of the Volta Manufacturing Company, Limited, at St. Catharines, Robert T. Turnbull, draughtsman and John Young, foreman and J. W. Simpson, foreman of Welland and C. W. Sim of St. Catharines has been granted incorporation by the Ontario Government. The Company will continue to carry on the business of electrical, mechanical and hydraulic and civil engineering etc. The capital stock is fixed at $200,000.

Steel Workers Want $1 an Hour.

Structural steel workers of Toronto, whose ultimatum to steel-erecting firms expires April 1, met and decided to stand by their demand for $1 an hour and a forty-four hour week.

Vancouver.—G. S. Pettapiece, managing director of George Craddock & Co., B. C., Ltd., has purchased nine acres at tthe corner of 17th Avenue, and Yew Street, Vancouver, B. C., on behalf of George Cradock & Co., Ltd., Wakefield, England, for the erection of a plant for the manufacture of wire rope, steel cables, etc., to take care of domestic business and trade with the Orient. One of the parent company's engineers is on his way to Vancouver from England to superintend construction, which will be started at once.

Regina.—Crane, Ltd., Montreal, manufacture of plumbing, heating and engineering supplies, has purchased a site here, where it will establish a branch plant.

Ingersoll.—The Ingersoll Machine & Tool Co., Ltd., has been incorporated with a capital stock of $1,000,000 by James L. Ross, 72 Isabella Street; Arthur W. Holmstead, room 43, 20 King Street East, and others.

Sarnia.—The site purchased on the Indian Reserve last fall by the Wills-Lee Auto Corporation is being prepared for the erection of its new $3,000,000 plant.

Walkerville.—The Eclipse Counterbore Co., Ltd., has been incorporated with a capital stock of $40,000 by Wesson Seyburn, Roy G. Mitchell, Charles Wright, Jr., and others, to manufacture counterbores, lathes, drills, drill presses, reamers, chucks, cutters, etc.

Aurora.—J. Fleundy's Son's, Wellington Street, will start work early this spring on the erection of a molding shop, etc.

Sarnia.—The Sarnia Bridge Co., Ltd., has been incorporated with a capital stock of $500,000 by Roy M. Norton and Harry B. Fenton, of Port Huron, Mich.; Henry F. Holland and Henry M. Pardee, of Sarnia, Ont., and others

Sarnia.—The St. Mueller Mfg. Co., Ltd., has been granted permission to increase its capital stock from $500,000 to $1,200,000. It will also extend its business to include an iron and brass foundry and other lines.

Brockville.—B. Dillon, architect, 43 King Street, East Brockville, Ont., is preparing plans for the erection of a foundry to cost $60,000 for Machinery & Foundries, Ltd.

Georgetown.—The Canadian Needle Works has acquired the F. W. Corey Needle Works, Hamilton, Ont., and is removing the plant to Georgetown. The capacity of the present works will be doubled by the erection of an addition.

Toronto.—The Anglo-American Motors, Ltd., has been incorporated with a capital stock of $10,000,000 by John P. Ebbs, Duncan R. Kennedy, Edward R. Jackson and others, all of Ottawa, to manufacture automobiles, motors, etc.

Toronto. Moffats, Ltd., has been incorporated with a capital stock of $1,000,000 by James L. Ross, room 43 20 King Street E., Arthus B. Mortimer, Arthur W. Holmestead and others to forge and manufacture iron and steel products, machinery, etc.

Toronto.—The Canadian Metal Window & Steel Products, Ltd., has been incorporated with a capital stock of $250,000 by Gerald M. Malone, Toronto General Trusts Building; Frederick L. Whitley, 434 Manning Avenue, and others.

Oshawa.—The Purdy Co., Ltd., has been incorporated with a capital stock of $40,000 by Norman W. Purdy and Robert E. Jones, Orillia, Ont.; Russell B. Horn, Huntsville, Ont., and others, to manufacture sheet-metal products, etc.

Guelph.—The Moncrief Furnace & Mfg. Co., Ltd., has been incorporated with a capital stock of $50,000, by Elmo S. Moncrief, Cleveland, Ohio; Wellington J. Shibley, John R. R. Howitt, and others of Guelph, to manufacture furnaces, stoves, radiators,etc.

Walkerville.—The Kales Stamping Co., Ltd., has been incorporated with a capital stock of $50,000 by William R. Kales, James T. Whitehead, Walter J. Leitheiser and others, all of Detroit, Mich., to manuufacture sheet-metal stampings, automobile parts, etc.

Toronto.—The Canadian Tygard Engine Co., has awarded the general contract to Walter Snelling, 66 Hiawatha Road, Toronto, for the erection of a carburetor plant to cost $40,000. H. R. Watson is the architect and E. O. Ewing, engineer, 907 Excelsior Life Building, Toronto.

Toronto.—The plant of Steel & Radiation, Ltd., has been purchased by the Canadian Metal Co., Fraser Avenue. It consists of six one-story buildings and will cost, with the necessary alterations, $250,000. The new building will be equipped for the manufacture of cement tubs and will also be used to increase the output of the nail and wire departmnet and its general smelting and refining business.

Smiths Falls.—The Smith Falls Malleable Co., Ltd., have remodelled and re-equipped their No. 1 plant which has been closed down for the past five years for re-opening. This plant is situated on a tract of 3½ acres, fronting the Rideau River, and contains 60,000 square feet of floor space. The Company have in the interval been running their No. 2 plant, which is a much smaller proposition, but, owing to great expan-

sion in business, have found it necessary to re-open the larger plant. They are manufacturers of all lines of refined air furnace and castings, making a specialty of railway castings. Recently they have accepted a very considerable tonnage for United States export, both in automobile and railway castings, and the capacity of No. 2 plant has been exceeded. In their No. 2 plant they are employing approximately 100 hands. With No. 1 plant also in operation they will have 300 hands. The capacity will be increased from 2,000 to 8,000 tons.

Toronto.—The British Canadian Machine & Tool Co., Ltd., which has been formed with a capital stock of $500,000, has taken over the International Machine & Tool Co. and the Reliance Motor & Tool Company, and is now carrying on business at 183 George Street and 111 Adelaide Street, Toronto. It is contemplating the erection of a manufacturing plant in the city. The directors are Thomas L. May, Harry A. Newman and John G. Baukat.

Woodstock.—The Standard Tube & Fence Co., Ltd., has acquired the Canadian patents of Marshall B. Lloyd covering acetylene and electric welded tubing and has also formed a working agreement with the Standard Parts Co., Cleveland, Ohio, to manufacture in Canada many of the latter's line of welded products. The company is installing equipment to carry out this undertaking and is also contemplating adding to its plant.

Toronto.—The Tube Co. of Canada, Ltd., has obtained premises at 233 Dufferin Street, and will manufacture welded steel tubing ranging from 3-8-in. to 2-in. outside diameter and thickness of 14 to 20 gauge. The capacity of the plant will be 30,000 ft. per day, hot or cold finish, and the equipment will consist entirely of automatic welding machines. The officers are W. W. Carter, president; P. Sorley, secretary-treasurer, and J. F. Lawson, vice-president and general manager.

Montreal.—The Dominion Welding Mfg. Co., 576 St. Timothee Street, will erect a new plant on its present site to take care of increasing business. It plans to go into the manufacture of water heaters.

Montreal.—The Canadian Tilsoil Farm Motors, Ltd., has been incorporated with a capital stock of $100,000 by Frances G. Bush, George R. Drennan, William F. Creagh and other to manufacture farm machinery and tools.

Montral.—MacGovern & Co., Ltd., has been incorporated with a capital stock of $350,000 by Maurice Dugas, Benjamine Robinson, Clarence F. McCaffrey and others to manufacture electrical equipment, iron and steel products, etc.

Montreal.—Simmons, Ltd., has been incorporated with a capital stock of $500,000 by William S. Morlock, 85 Bay Street; Sydney E. Wedd, 162 Jameson Avenue; Roy B. Whitehead and others all of Toronto, to manufacture metal beds, furniture, etc.

Levis.—Following the re-organization of the Davies Shipbuilding and Repairing Company at Levis, Que., that organization has entered upon new activity, and is now employing 1,200 men. The 5,000-ton steel freighter recently launched for the Canadian Government Merchant Marine is being completed. Repair work includes rejoining a vessel that was floated down from the Great Lakes in two sections. Fully a dozen other craft are being repaired

Sherbrooke.—The Sherbrooke Iron Works has been acquired by George L. Dourne and F. A. Schauff, of New York City, who will operate it under the same name. New machinery will be installed for the manufacture of locomotives, marine and stationary superheating apparatus, as well as other steam specialties. It will also continue to do a general foundry and machine shop business.

DUPLEXING WITH THE CUPOLA.

The prominence the electric furnace has attained in steel foundries in this country and more recently as a melting medium for brass and other non-ferrous castings has tended to obscure the use of the electric furnace as an adjunct to the cupola. Both in gray iron and malleable foundries it has demonstrated its usefulness as a refining and superheating medium. There is no claim that it can displace the cupola as an efficient melting unit; but the results as presented in papers before the American Foundrymen's Association and as demonstrated from other sources point to a highly important function of the electric furnace as an adjunct to the cupola. The fact that it can accomplish in temperature what the cupola cannot is of much industrial value. This is particularly true where ordinary iron produced by the usual process has not met a particular demand. It has been found that a superheated iron, incidentally refined, possesses properties which meet the most exacting specifications.

Duplexing with the cupola, it is also claimed, permits the production of iron of any desired carbon or silicon content by making the proper additions to the bath of the electric furnace. There is also possible a large increase in the amount of scrap charged in the cupola and a decrease in the fuel. Even steel scrap can be admixed in the electric furnace, making possible the attainment of a carbon-diluted gray iron or semi-steel—possibly an improved product. Besides this there is the possibility of a considerable saving in manganese by the use of low manganese material in the cupola, where the loss of this element is always large, and the addition of the manganese in the electric bath, where this loss is small.

The most important of the advantages resulting from duplexing with the cupola is that of refining. It is possible to reduce a cupola iron of 0.20 per cent sulphur down to 0.057 per cent sulphur in 15 minutes in the electric furnace, according to one of the papers referred to. The application of this principle to malletable castings has for some time been demonstrated by a large American company. In the near future, according to a well known authority on iron foundry problems, the electric furnace may become a necessity as an agent to reduce sulphur in gray iron in general. As a result of the war, sulphur has been and is accumulating to a noteworthy degree in scrap iron and resort may be had to the electric furnace as the medium which will overcome this menace."—Iron Age.

NOVA SCOTIA STEEL COMPANY LAUNCH "CANADIAN MINER."

The Nova Scotia Steel Company, on April 3rd, launched the "Canadian Miner," a 3,000 ton d.w. freighter for the Government. This makes the sixth vessel built at the Trenton Yard. Another vessel will be launched in July, and it is expected that two other larger steamers will be launched before the end of 1920.

THE FUTURE PROSPECTS OF ELECTRIC SMELTING OF IRON IN BRITISH COLUMBIA.

By RONALD CAMPBELL CAMPBELL-JOHNSTON In "The Mining Journal" (London, Eng.)

A splendid "number 1" grey pig iron, absolutely free from sulphur, and well within the Bessemer limit of half of 1 per cent in phosphorous contents, has already been obtained in the electric furnace from the British Columbia magnetite iron ores, without any admixture with other peroxides such as hematites, limonites, wad, or some low grade iron compounds, and with only the addition in the furnace of carbonate of lime flux and charcoal fuel. This Vancouver pig iron compares most favourably with the best British brands.

The Vancouver Magnetite Iron & Steel Smelting Co., Ltd., are the only firm so far in the Province who have solved this most important problem locally, and have already made a splendid grade of pig iron, consisting of a parcel of small tonnage, in their demonstrating plant.

An iron and steel plant in Eastern Canada, originally costing over £3,000,000 sterling, and lately acquired at a high figure by British interests, has been courageously completely scrapped, with the immediate erecton commenced of an up-to-date new co-ordination of processes to supply an almost unlimited demand, east and west. To date, the metallurgical engineers have concentrated their attention on the production of pig iron when designing electrical furnaces to turn out metal in bulk on a cheap scale; but a future, also fully as important in all branches of brass foundry and other businesses, may be imagined, together with the electrical smelting of copper ores, nickel, cobalt, zincblendes, galena, manganese, magnesium, aluminum, gold, silver, platinum, and its group metals, molybdenum, tungsten, and, in fact, all the metals used in commerce alone or alloyed. There was nothing particularly new about the designing and operating of the plant erected by the Vancouver company above mentioned, whose consulting metallurgical engineer the writer was during the experiments carried out, but the careful application of known ideas consummated most happy and successful results. Mr. Wilson Dredge Fleet, the electrical engineer, with experience from Sudbury, Ontario, and other eastern Canadian places, planned a simple long trough-shaped furnace, constructed suitably for this particular purpose, of the following inside dimensions: 8 ft. by 6 ft. by 3 ft. These dimensions can be varied at will. The stipulated capacity of the furnace mentioned here per 24 hours' run was 25 tons of pig iron, produced from magnetite ore carrying from 60 to 64 per cent metallic iron plus the necessary carbonate of lime flux and charcoal fuel. The furnace is preferably left completely open over the whole top, and fed evenly and constantly from the top, flush with the feeding floor. The interior sides are narrower towards the bottom of the bath that is below the carbon electrodes, which are placed, slightly so protected, back from the overhanging interior sides of the furnace, along the full length almost on both sides, about 2 ft. from the bottom of the furnace, that is above the only tap-hole, to leave that sized receptacle for the molten charge, having this ordinary single tap-hole at the end of the furnace, not to interfere with the arrangement of the electrodes, to drain the whole contents of furnace clean, the floor being sloped towards this aperture.

The electrical connexions, from the usual regulating transformers to the electrodes, will be known to all electrical engineers. A steady temperature of around 3,000 degs. F., to keep well above 2,780 degs. F.—the recognized melting point of magnetite— a degree of heat not obtainable by the ordinary iron blast furnace, was the proper degree to maintain here.

The furnace was kept evenly charged all the time with a well shovelled and coned up mixture, broken into two inch cubes and less, to near its top. This is essential, since the temperature of the furnace immediately dropped to comparatively nothing directly the resistence to the flow of the current was removed, when the charge passed below the level of the electrodes. The bath was tapped whenever the molten charge rose close to the carbon electrodes. A very important adjunct to the plant was a "Root" blower for supplying blast, playing into the furnace to furnish oxygen for combustion below the carbons, also to freely circulate and disseminate the flow of juice (electricity- evenly throughout the whole charge in every part of the fusion zone, and so prevent a direct flow only from pole to pole, without proper distribution for melting purposes. As it was necessary to maintain this high temperature constantly in the furnace in order to carry on effective work, owing to the expense of magnesia bricks, it was considered inadvisable to attempt any complete reduction of the charge to metallic pig iron in this primary furnace. The sole object in view was to break down the protoxides and other constituents forming magnetites during this first part of the process, and in order also to increase the duty of the furnace, it was decided to tap out as speedily and continually as possible—roughly, every 45 minutes—into an adjoining reverberatory furnace without losing any heat contained in the charge during the transit, and to finally reduce to metallic pig iron from the slag in this secondary furnace at , say, two-thirds of the first heat. It must never be forgotten that, like most Scots, who hate to lose anything once gained, the late Andrew Carnegie amassed his fortune from properly conserving the heat in his iron and steel as it passed from stage to stage. He even wisely bonused his several foreman of the various departments and the men under them for gaining any new success in this important detail; and moreover, sent out certain of his experienced employees to travel everywhere and anywhere at his own expense to enable them to catch on to any possible new wrinkle, carrying this necessary conservation of heat in view.

This Vaincouver company's working capital came to an end at this initial success with the electrical smelting furnace, so they shipped this fused material of ferrous oxides derived from this primary furnace, and had it reduced easily into pig iron in a neighbouring foundry cupola, and so produced a splendid "No 1" grey pig iron; which as a continual duplex process can be always repeated and kept in constant operation whenever the requisite financial assistance arrives to carry out the proper installation of several units to turn operations into normal and most lucrative business. Mr. Percy Hugh Fraser, nephew of Graham Fraser, who first produced pig iron successfully in a blast furnace from hematites in Eastern Canada, and so instigated pig iron production in this Dominion, is the managing director, organiser, and business head of this Vancouver company. With the necessary capital in hand, there is no difficulty now in leading the fused charge, as it is tapped from the electrical fur-

nace, under an open archway connecting the two furnaces into an immediate adjacent reverberatory furnace, for reduction into high-class pig iron, allowing all the time really requisite for proper prolonged reduction reaction, without unduly crowding—for chemical reaction is a slower matter and operated at a lower temperature than mere fusion and the breaking-up of the chemical stability at a higher heat. A stack, not too large, but of sufficient height, connecting only with the end of the reverberatory furnace, and through that and the archway with the electrical furnace, will draw out also and conserve almost the full heat from the primary furnace.

Hot blast, derived from the furnace itself, will later be installed to be driven into the electrical furnace to distribute the flow of juice, but is not important. In fact, however, as the whole process gets into steady action many other improvements will readily occur to the minds of the operating metallurgist, and be at once installed to improve and cheapen in every way the total cost of pig iron production. A decidedly cheap, rapid, and effective method of turning out good charcoal for fuel, preferably to be used instead of coke or hard coal, to furnish the requisite carbon for reduction to pig iron, on account of the absence of sulphur and other deleterious impurities generally contained in coke or hard coals, has been locally perfected, to utilise any and all indigenous woods, and at the same time produce high-class valuable by-products—such as turpentine of forms of pyrogallic acid—for later refining into its several commercial products, according to and regulated by whatever specific temperature may have been maintained, during the process of destructive distillation, while making charcoal. Suitable brick stalls are built in rows, back to back, having for entrance iron doors to form hermetically sealed kilns when in use. Wood cut into suitable sizes is piled high, each tier crossing the lower one, on wholly iron flat cars having low wheels, which are run into each stall, and the doors closely fastened. A flue, now the only outlet, with a return inlet connects the inside of the stall with a large main iron pipe leading to a centre stove, and along which all exuding gases are drawn by an exhaust blower as the interior of the stall becomes heated by returned hot carbonic gas. These gases coming along the outlet pipe are forced through closed stoves, heated by electricity, kept at an even temperature to produce the desired product, which process dries the incoming gas, removes all liquids for consideration, and returns to the stall along the return pipe only highly heated carbonic acid gas, which prevents oxydisation, and so combustion of the wood piled on the cars, thus permitting a complete charring, when in about six hours the finished charcoal is ready. The flues are then both closed, the doors opened, and the car withdrawn from the stall, loaded now with a fine grade of charcoal fuel. This process is simple and effective, and without counting the price to be obtained for the by-products collected, affords a high class material at a cost of, say £1 sterling per ton of charcoal, delivered at the smelting plant from timber berths not too far away.

The costs so far incurred in turning out pig-iron at this Vancouver plant are as under:—

Cost of electrical power per ton of pig iron produced at 0.5 cents per kilowatt-hour	$1.00
Interest, depreciation, and sinking fund	0.20
Labour	0.60
Maintenance and repair	0.50
Total fusion cost per ton pig-iron	$2.30
Cost of three 25 ton unit furnaces (without transformers)	$20,000.00

For subsequent treatment in reducing reverberatory furnace, as follows:—

One and two-thirds tons (60 per cent) magnetite iron ore, delivered	$6.00
One ton of coke, hard coal, or charcoal	6.00
Two-fifths ton of limestone	0.50
Labour	2.00
Overhead charges	0.50
Amortisation, management	0.50
Total costs per ton pig-iron	$15.50
Total	$17.80
Or, for safety, including interest on purchase of mines, smelter site, power installation of hydro-electric, timber berths, and other assets held, say £4 sterling =	$20.00

The wheels of commerce here now only await the requisite capital to secure by purchase an ample supply ahead of assured iron ore to satisfy continual and successful operations during the next fifty years There exist limestone quarries on the seaboard, large timber limits for future charcoal production, and preferably control of the anthracite smokeless steam coals from the coalfields of the Groundhog district, and also the extensive deposits of hydro-magnesites from the Cariboo district.

Then there are suitable smelting sites open on the seaboard connected already with transcontinental land, coastal steamer, and trans-oceanic communications, reaching all ports, especially those bordering on the whole Pacific Ocean, offering already a tremendous market for the export of pig-iron, steel billets, and finished manufactured articles of commerce. These smelting sites in mind are adjacent to hydro-electrical power sources, costing for installation, say, $45 per horse-power.

Bonuses are offered by the Provincial Government for a certain term of years. In fact, all the possibilities exist for building up splendid industrial concerns here in British Columbia now that all the requisite problems to suit local conditions have been solved.

BRITISH COLUMBIA GOVERNMENT PROPOSES RESERVATION OF IRON-ORE DEPOSITS

The Bill now before the Legislative Assembly giving the Lieutenant Governor in Council power to place a reserve on iron ores deposits, the said power to extend over a period of three years, will be applied to a limited extent, and the authority so granted will be exercised, not to the detriment, nor in such a way as to inflict any hardship of interference with the prospector of any class of people interested in the mining industry. Rather it will be used for the advancement of the interests of those directly or indirectly concerned in the development of the mineral resources of the Province, as well as for the benefit of the public at large.

To the criticism that the bill will hamper the prospector it may be replied that he had not heretofore and cannot at present benefit materially by reason of the discovery and location of purely iron deposits.

Without an Iron and Steel Industry in Western Canada there is not a sufficient market, if any, to make the product of such holdings saleable. That the force of this is recognized by the prospectors is confirmed by a statement voluntarily given to Hon. Wm. Sloan, Minister of Mines, who is responsible for the proposed legislation, by J. W. Mulholland, President of the Prospectors' Protective Association, who says in part:

"The iron deposits of British Columbia have in the past been of no value to the prospector. This class of ore is absolutely useless. By reserving districts which are idle and not covered by mineral claims there should be no reason or ground for opposition, for, if we have a Steel Plant in the Province, it would furnish a market for ores which are now being held by the prospectors of the Province and which would remain idle until such time as this market is created. Considering the benefits which this Province would derive from an industry of this kind I feel it my duty to give you (the Minister of Mines) my approval.

To the charge that present holders and operators will be adversely affected it is only necessary to direct attention to the fact that the authority asked for does not apply to iron ore locations already held until the Mineral or any other act.

The object sought, briefly, is to prevent the further alienation of the iron ore resources to such an extent that their development is impeded. At present many such deposits are privately held and on none has much work been done. The only conclusion possible is that they were acquired, and are being held, for speculative purposes, a situation which, it must be clear, handicaps the efforts being made to interest capital in the development of Iron and Steed Industry, an enterprise most important if British Columbia is to take the place her mineral riches warrant in the industrial world. An illustration in point is found on Texada Island where there are large iron ore deposits, of high grade, which have been out of the hands of the Crown for fifty years or more and on which there has been little expenditure in development.

While it is not intended to touch the unquestioned rights of these who have complied with all the laws heretofore, and have kept their properties in good standing, it is proposed that for a time such properties of this character, as may be deemed as of sufficient importance, shall be reserved by the Crown.

On the report of the discovery of iron ore, the resident engineer of the district in which such find has been made will be asked to inspect and report on the same. If it is considered on investigation that the ore is so situated, is in such quantity and of such quality as to warrant the belief that it might assist in the object in view, namely, the launching of an Iron and Steel Industry, the government power to apply the reserve probably would be exercised.

OPENED OFFICE IN TORONTO

Alfred Herbert, Ltd., of Coventry, England, manufacturers of tool machinery, turret lathes, milling machines, etc., are about to enter the Canadian field and have opened a temporary office in the Board of Trade Building, Yonge Street, Toronto. The Company also represent a number of other British machinery firms in Canada. It is intended to get warehouse premises in Toronto and carry comprehensive stock of the Company's products.

THE YEAR IN STEEL.

Developments Following the Armistice in the Iron and Steel Industry of Canada—By F. W. Gray.

Following the Armistice, the iron and steel industries in Canada, as was the case in Britain and in the United States, passed through a period of uncertainty Under the stimulus of the war, in 1917, the production of the blast furnaces and steel furnaces of Canada reached its highest recorded point. For some time preceding the armistice, however, the larger steel manufacturers, foreseeing the impending end of hostilities , had gradually lessened the production of munitions and proceeded to equip their plants for peace-time requirements. In this way, the Canadian plants had in large measure disposed of their war-time equipment at good prices, had made suitable amortization provision in their accounts to take care of the special equipment installed for war purposes, and did not experience so severe a dislocation of their manufacturing activities when the war ended as less capable management might have occasioned.

As a result of war-time activities and prices the steel companies had accumulated considerable surpluses, but here again the managements showed their wisdom in preferring to invest the money in additions and rehabilitation of plant rather than in the disbursement of dividends.

Just previous to the war the steel industry had met some very lean times, and the reversal in their financial position which the last five years has brought about is shown by a comparison of the relative value of their common stocks, as appraised by the Stock Exchage, and as shown below:

Prices in 1913:—

Low	\$37.	\$18.
High	58.	28.
A year ago	62.	65.
End 1919	75.	86.50

The value of Canadian steel stocks, of which the two instances given are typical, is a reflection, not so much of their future prospects, which is of course something on which no person can be certain, but of the improved physical condition of the plant and equipment of the several companies, and the notable additions that remain as a permanent gain of the period of war activity

Large Extensions.

For example, without going into great detail, new and up-to-date by-product coke plants have been installed by the Dominion Steel Corporation at Sydney, by the Steel Company of Canada at Hamilton and by the Algoma Steel Corporation at Sault Ste. Marie. The large steel companies have all also strengthened their position by acquiring additional coal properties. The Dominion Coal Company has very notably increased its coal holdings in the Glace Bay district during the war. The Nova Scotia Steel and Coal Company has recently obtained control of the Acadia Coal Company in the Pictou field of Nova Scotia, and both the Algoma Corporation and the Steel Company of Canada have strengthened their position by the acquirement of coal properties in the United States. The position of the steel companies in regard to fuel economy—which is the great problem in steel manufacture today—is very much better than it was before the war.

Another encouraging tendency of the steel manufacturers has been to increase the variety of their manufactured products. The new structural steel ex-

tensions of the Algoma steel Corporation, the plate mill of the Dominion Steel Corporation are typical of what is taking place.

The growth of the shipbuilding industry is closely connected with the growth and permanence of our Canadian Steel industry. Steel shipbuilding plants now include the important and large ship-yard at Halifax, the Nova Scotia Steel Company's old-established yard at Trenton, near New Glasgow; the numerous establishments along the St. Lawrence river, at Quebec, Three Rivers and Montreal; the yards in Toronto, Collingwood, Port Arthur and other points on the Great Lakes, and the very important shipbuilding developments on the Pacific coast. Now that a plate-mill, capable of rolling large size ship-plates is about completed in Canada, the country is in a position to furnish within its borders everything necessary to build and equip steel ships for sea, including engines, boilers and accessories.

Consolidations Likely.

It is in the logic of events to anticipate a consolidation of interests, including coal mines, iron-ore deposits, steel plants, and steel-ship building yards, along the lines that have been so successful in Britain, where it is often stated that the ore comes in at one gate and the steel ship goes out at another. It is possible by a consolidation of such allied interests, which are all founded upon coal and the heat that comes from coal when burned, to utilize that heat more completely and scientifically when all the surplus gasses, and the by-products of combustion are concentrated in a compact area, enabling process to follow process without loss of time or heat, and facilitating what is today known as straight line production. If such consolidations take place in the future, they should not be looked at askance, or regarded as undesirable, but should be recognized as the only way in which our basic industries of coal-mining, steel manufacture and shipbuilding can be developed to a point where they can stand on their own legs and enter the competitive markets of the world.

The weakness of the steel industry in Canada lies in its too great dependence on the United States for supplies of iron ore and coal. Only five per cent of iron ore reduced in Canadian furnaces is mined in Canada, although a large tonnage, at least 900,000 tons annually, comes from the Canadian owned mines at Wabana, Newfoundland. Canadian iron ores are plentiful, and well distributed, but they happen to be temporarily discounted in value by the more accessible, cheaper and more easily reducible iron ores on the United States' side of the Great Lakes. Some day, Canada's ores will prove a source of great wealth. In the matter of coal, Canada can, to a much greater extent than she has hitherto done, please herself whether she mines coal at home or goes to the United States and pays out good money for coal there. Canada has lots and lots of good coal, and is under no compelling necessity to spend some $50,000,000 annually in the purchase of United States coal.

Prospects in British Columbia.

An interesting subject at this time is the desire of British Columbia to have a steel industry in that province. The permanence of the ship-building industry there almost requires a steel industry on the Pacific coast, and the probability is that before long a beginning will be made in the manufacture of steel, and possibly in the reduction of iron ores to pig-iron, in British Columbia. Wherever coal is found of suitable quality, and in sufficient quantity, an iron and steel industry is bound to follow the development of the coal fields, even should it necessitate the transportation of iron ore and fluxes for some distance, because the metal industries, from the mining of the metalliferous ores to the final fabrication of the finished metal, are entirely dependent on coal for motive power and heat—with some notable exceptions where large quantities of electricity generated by water-powers are available. Coal is the most important and basic raw material of the modern world. It is a first necessity of national defence and national independence, and no country can achieve industrial importance without coal. Therefore, that country which is most generously supplied with coal is most likely to lead in industry. In Canada, that most favored district is Alberta, which has within its borders more coal than all the remainder of Canada, and more coal than any one state in the American union—By the Editor in the "Grain Growers Guide."

PRIZE FOR HARDNESS TESTING DEVICE.

It has been announced that Sir Robert A. Hadfield has placed in the hands of the Institution of Mechanical Engineers of Great Britain the sum of £200, which, with any income therefrom, may be awarded as a prize for the description of a new and accurate method of determining the hardness of metals, especially of metals of a high degree of hardness. The ordinary tests of hardness fail to some extent when the hardness of the material exceeds about 600 to 800 Brinell. What is desired is the description of a research for or an investigation of some method for accurately determining hardness, suitable for application in metallurgical work in cases in which present methods partially fail. The award will be made by the council of the Institution of Mechanical Engineers, whose decision will be in all cases final. The council will consider annually all communications received, and may then award a prize. But in January, 1922, the offer of prizes will be withdrawn, and any unexpended balance of the prize fund will be diverted to any other purposes to be determined at the discretion of the council. The council may award the whole or any part of the sum available at any time if a communication is received which, in their opinion, is of sufficient originality and importance and satisfies the object aimed at; or they may from time to time award portions of the fund, not exceeding in all £75 in any one year, for communications which do not completely solve the problem, but which appear to advance the knowledge of methods of testing hardness. The institution will probably be willing and reserve the right to publish in its journal any communications for which a prize is awarded. A communication should be accompanied by scale drawings of any new apparatus described, or by a model or an example of the apparatus itself. If the communication describes a new invention, likely to be of commercial value, it is desirable that provisional protection should have been obtained before it is submitted for consideration. Nothing is said as to whether the competition is confined to British contestants or is international; but information on this point may be had from the Secretary, Institution of Mechanical Engineers, London, England.

BOOK REVIEW.

ELECTRIC FURNACES IN THE IRON & STEEL INDUSTRY: Rodenhauser, Schoenawa and vom Baur. Third edition, revised. Translated from the German original by C. H. vom Baur, formerly Chief Engineer of the American Electric Furnace Company. 460 pp. with Index. Cloth boards, 6 ins. by 9 ins. John Wiley & Sons, New York. $4.50.

This is a revised reprint of a combined work by two German writers published in 1911, and first published in an English translation in 1912 by C. H. vom Baur. The work was added to and republished in 1917, and this review is of the edition of December, 1919. Part I. deals with Electric Furnaces, their theory ,construction and criticism. Part II. treats of materials for furnace construction and the costs of operation, and are both written by W. Rodenhauser, formerly of the Roechling Eisen und Stahlwerke, Volklingen. Part III. treats of the electro-metallurgy of iron and steel, and is written by J. Schoenawa, works manager of the Roechling plant. Herr Schoenawa's introduction, with the concluding "Gluck Auf!" reads rather curiously in 1920, when one considers the history of the Roechling enterprise since 1914, and the fate that has befallen the Roechling Brothers.

Apart from these considerations, the work appears to be an important contribution to the growing literature on the application of electric heat to the reduction of iron ores, the refining of iron and the manufacture of modern steels.

In the preface to the first edition, vom Baur predicted his belief that electric furnaces for the iron and steel industry would have their greatest future on the North American Continent, and in the second edition of 1917 was able to record that out of a total of 562 electric furnaces in the iron and steel industry of the world, there were in Canada and the United States 212 of these furnaces. In the 1920 edition, it is stated that there are either built or building, for the melting and refining of steel 1,000 furnaces, and the statement is made that "the next ten years will no doubt witness more than double the number of electric furnaces in existence today."

The evolution of the electric furnace is reviewed historically, it being pointed out that the development of electric heat on a large scale was not possible until the modern dynamo had made it possible to produce current economically, continuously, and in sufficient volume. Reference is made to the Stassano furnace patented in 1898, followed by the Héroult and the Kjellin, which appeared almost simultaneously in 1899 and 1900, all three being operated by electricity generated from large water-powers. An important contributing factor, it is stated, was a report by Dr. Haanel, who was sent to Europe with a commission of experts to study the electric furnace and its possible application to the iron and steel industry in Canada. This report first brought together the different existing types of furnaces and compared them. The result of the Canadian Report was to make it evident that at that time, namely, 1904, the electro-steel industry had attained a healthy existence, at least where in proximity to water-power developments. Reference is made to the Keller furnaces at Livet, regarding the useful activity of which

TABLE OF ELECTRIC FURNACES IN THE IRON AND STEEL INDUSTRY, BY COUNTRIES OF THE WORLD, OPERATING OR CONTRACTED FOR JULY, 1919, WITH TOTALS FOR 1918, 1917, 1916, 1915, 1913, AND 1910

	Héroult	Girod	*Induction	Stassano	Keller	Chaplet	Nathusius	Snyder	Booth-Hall	Rennerfelt	†Gronwall	Greene	Greaves-Etchells	Vom Baur	Moore	Stobie	Ludlum	Special	Total July 1, 1910	Total Jan. 1, 1918	Total July 1, 1917	Total Jan. 1, 1916	Total Jan. 1, 1915	Total July 1, 1913	Total March, 1910
‡Germany and Luxemburg	43	7	40	2	3		6			1									102	91	64	53	46	34	30
‡Austria, Hungary, and Bohemia	19	3	6	2						1								4	35	31	20	18	18	10	10
Switzerland	2	2	1							1									6	5	4	4	3	2	2
Italy	10	1	3	19						...	1							14	48	40	29	22	22	20	12
France	29	9	2	..	5	5				2				2				7	61	50	40	21	17	13	23
Great Britain	53	1	4	4				8		7	33		33			8		8	159	131	94	46	16	16	7
‡Belgium	2		1																3	3	3	3	3	3	3
‡Russia and Finland	3	1	1	2						12	2								21	21	21	11	9	4	2
Sweden	4		2							40	2							1	49	50	45	23	18	6	5
Norway			3							15								3	21	12	9	6	2	3	...
Denmark										2									2	2	2				...
Spain			1								1			2					4	2	2	2	1	1	...
Japan	1		1					2		2				3				2	11	4	2	1	1	1	..
Mexico			1																1	1	1	1	1	4	3
Australia											1							1	2	1	1	1			..
Chile								1		1							1	2	5	2	2	1	1	...	...
‡Roumania	1																		1	1	1	1		...	...
India								1											1					...	...
South Africa			2																2	2			...	...	...
Brazil										2				1					3				..	...	...
Location not given			12															9	21	21	21	9	...	...	...
Total outside U.S.-Canada	167	24	80	29	8	5	6	12	..	86	40	..	33	8		8	1	51	558	470	361	223	158	117	97
United States	146	5	5	1				45	11	12	12	9	11	3	12	..	11	8	291	233	177	73	41	19	10
Canada	19	...	...	...	...	...	...	3	...	...	1	...	...	...	...	...	...	21	43	36	34	8	2	3	3
Total U. S. & Canada	165	5	5	1	...	...	..	48	11	12	13	9	9	3	12	..	11	29	334	269	211	81	43	22	13
Grand Total in World	332	29	83	30	8	5	6	60	11	98	53	9	44	11	12	8	12	82	895	739	572	304	201	139	110

* This includes Kjellin, Röchling-Rodenhauser, Frick and other induction furnaces.
† Electro-metals Company in Great Britain.
‡ Reports for 1916 to 1919 not complete.

during the war period readers of "Iron & Steel" are informed. (See March issue, page 62, on the making of synthetic cast iron at Livet, by G. A. Keller).

The theory of electric furnace practice is very thoroughly discussed, and the following requirements of an ideal furnace are postulated:

a. The ability to use any prevailing alternating current at any voltage or frequency.

b. The avoidance of any sudden changes in the load.

c. Ease of regulating the incoming current.

4. High electrical efficiency.

To these main considerations are added the following: A furnace of the tilting variety, with easily surveyed and accessible hearth. The electric heating, or any of its necessary auxiliaries must in no way influence the chemical composition of the steel or the slag. There should be ability to reach any desired uniform temperature in all parts of the bath, at the same time avoiding local under-heating or over-heating. The furnace should be as versatile in its application as possible. Existing types of furnaces are examined and criticized as to fullfilment of these essential requirements. Arc furnaces are discussed in general, and in particular, the Stassano, Héroult and Girod types are enlarged upon. The Rennerfelt furnace is discussed as the type of directionalized radiating-arc furnaces.

The induction furnace is also discussed in general, and in particular the Kjellin and Roechling-Rodenhauser types are described. The author considers the induction furnace, particularly in the larger units of this type, more nearly fulfills the requirements of an ideal furnace, as stated by him.

The electric shaft furnace is discussed, this type being designed to take the place of the ordinary blast-furnace for the smelting of iron-ore. Reference is made to the tests made in Canada, in continuation of the investigations of the Canadian Commission, and to the work done by Héroult in Canada in 1906. The design of a successful electric shaft-furnace, it is stated, was not solved by the experiments made in Canada. Progress has been made, after many experiments, with the furnace of Groenwall, Lindblad and Stalhane. Fifteen furnaces of the latest type of this shaft furnace are now stated to be operating or building for Sweden. One other is being built for Aosta, Italy, and one for Japan. These furnaces all operate with charcoal, although it is stated that successful trials have been made with coke, the commercial use of which is prohibited by high cost. With Swedish magnetites of 57 per cent to 58 per cent iron, the power consumption per metric ton is about 2,200 kw. hr. With 50 per cent ore it increases to 2,500 kw. hr. The charcoal consumption is said to average 300 to 330 kg. per ton of pig-iron made, and the consumption of the best grades of carbon electrode averages 6 to 7 kg. per ton of pig iron made.

A general review of electric furnaces in operation includes the Keller arc-furnace, the Schneider-Creusot induction furnace; and the Greaves-Etchells, of arc-resistance type, a Sheffield (Eng.) development, for which the inventors claim "convection currents" in the molten metal, ensuring uniformity of product. The Synder, Greene, Moore, Booth-Hall, vom Baur and Ludlum types are fairly compared in detail.

Dealing with the electro-metallurgy of iron and steel, the concluding chapter of the work points out that in competition with the accepted practice of using heat supplied by coke, the electric process has only prospective use where ore and power are cheap, and coke is dear, as in some parts of Canada, Italy, Norway, Sweden, California, etc.

As to the future of electric steel, the writer discusses the possibility of duplexing with the cupola, which he considers offers a good field, particularly where it is desired to obtain castings of unusual tenacity, solidity and of high quality. Attention is also directed to this feature of the electric furnace in a recent editorial in "Iron Age," which is elsewhere quoted in this issue. The electric furnace as a mixer has many points of advantage, but so far the limitation of the capacity of the electric furnace has prevented advance in this direction.

The displacing of the crucible process by the electric furnace is regarded by Rodenhauser as inevitable, and some interesting figures are quoted showing the growth of the tonnages of electric steel in the leading steel producing countries of the world. The following condensed comparison is excerpted:

Electric Steel Produced in Metric Tons.

	1908	1918
United States	55	870,000
Germany	19,536	221,824
Great Britain	..	147,925
Canada	93	120,000

There is a good deal of history written into these figures, and the unavailability of the figures of French production from 1913 onwards is significant.

The general conclusions we draw from a perusal of the work is that while in its present stage of development electricity cannot compete with coke for the generation of the heat used in the iron and steel industry, it has certain specialised uses, the chief being in the refining of iron and the manufacture of high-grade steels in small quantities, which arise from the ease with which the temperature of the electric furnace is controlled within definite limits, the high temperature which it is possible to generate in the electric furnace for periods as long as desired, and the completeness with which impure raw materials can be refined.

In countries where waterpower is plentiful, and high-grade ores are obtainable, the electric furnace has most decided advantages. It may be said that it was these very conditions that impelled the invention and perfection of the electric furnace, as the pioneer work was accomplished in Sweden, France and Italy, where also the electric furnace is today used in greater proportion to the total iron and steel production than in the countries which possess sufficient coal resources.

No country resembles Sweden so much as portions of Canada in the possession of high-grade ores of iron, plentiful water-powers, and scarcity of moderately-priced coal suitable for metallurgical purposes, which accounts for the early interest taken in the electric furnace by the Canadian Government, and forecasts that Canada will in the future years play a prominent part in the development of ferrous electro-metallurgy.

DOMINION STEEL COMPANY DRILLING FOR IRON ORE

The Dominion Steel Company is drilling for iron-ore near Loch Lomond Cape Breton, about 30 miles from Sydney. Outcroppings of high-grade hematite are present, and diamond drilling is being undertaken to prove the extent of the deposit.

Influence of Enclosed Slag on the Corrosion of Wrought Iron*

By L. T. RICHARDSON, † Chemical Engineer, New Brunswick, N. J.

There exists at the present time a controversy relative to the factors that enter into and influence the corrosion of wrought iron. A study of the technical articles relating to the subject, on the one hand, and advertising literature on the other, shows that this controversy obtains only to a rather limited extent among purely scientific investigators of the corrosion of metals, but exists almost entirely among the manufacturers of different brands of iron. In view of this controversy, it was considered to be of more than passing interest to conduct experiments that might throw some light upon certain of the factors that are contended to greatly influence of wrought iron. The conclusions arrived at in this article are based upon these experiments.

The factors that enter into or at least are claimed to enter into the corrosion of wrought iron and which, moreover, are asserted to be the cause of its superiority as a rust-resisting material over other forms of iron are closely connected with the corrosion of ancient iron objects that have been exposed to the elements for years or centuries, for investigations have shown these objects to be wrought or puddled iron.

For instance, Sir Robert Hadfield examined several specimens of ancient iron, particularly the iron pillar at Delhi, India, and several iron implements of Sinhalese origin and concluded from an analysis and a microscopic examination that they were some form of puddled iron.

Walter Rosenhain, another investigator, tested a piece of ancient iron from Ceylon and found that it was similar in structure to wrought iron.

Likewise Dr. Hjdmar Braune described a pre-historic iron object found at Castanela, Switzerland. From a chemical and a microscopic analysis be concluded that it was an almost pure iron that had never been in the molten state. Similarly other investigators have recorded investigations of old irons 50 to 150 years age that have proven to be wrought iron.

It seems almost certain, then, from these published accounts that those ancient iron objects which have shown such a remarkable resistance to corrosion are made of puddled iron, and it is therefore only natural to expect that iron manufacturers of today in their search for a corrosion resisting material should attribute the rust-resisting qualities of these old irons to just those properties that characterize wrought iron itself. These distinguishing properties are two in number, a chemical one that the iron is quite pure, and a physical one that the iron has long layers or threads of slag or cinder scattered throughout its mass. Wrought iron we may then describe as consisting largely of pure iron throughout whose mass are scattered long threads or sheets of slag or cinder. Some even go so far as to say that each fiber is coated with an almost infinitesimal film of slag. It almost follows that because of these two different characteristics, the resistance of wrought iron to corrosion should be ascribed to two different causes by two classes of observers—one claiming that the resistance of wrought iron to corrosion is due mainly to its chemical purity; the other contending that it is due to its physical structure.

The exponents of the chemical theory contend that the resistance of wrought iron to corrosion, as well as the specimens of ancient iron, is due to the purity of the iron and hence that any iron that would duplicate the purity of the metal in the old irons would likewise be resistant to corrosion. The virtues of "ye olde time" irons they say are due to their purity and advocate pure iron as a "return to ancient virtues."

The believers in the physical theory, on the other hand, contend that the resistance of wrought iron to corrosion is due mainly to its physical structure and in particular to the form and distribution of its slag contents. They say that the method of manufacture is the important factor, for due to the fact that the iron never becomes molten in the puddling furnace quantities of slag are incorporated with the metal. The structure is similar to a bundle of compressed twigs in which each fiber of iron is covered and protected by a bark-like layer of slag. They claim that the slag is more rust-resistant to corrosion than is pure iron and forms a barrier as rusting penetrates into the metal, so that on reaching each slag inclusion the oxidation must take another course and begin anew. The adherents of this theory, therefore, advocate the use of wrought iron as the means of "defeating rust."

The remarkable part of the whole controversy is that neither side gives any direct and definite proof that their contention is true. For instance, the adherents of the pure iron theory do not show that pure iron metal with slag rusts equal to or faster than pure iron itself, nor do the adherents of the physical structure theory show that the metallic iron in wrought iron rusts faster without the slag than with it. This is probably due to the fact that it is impossible to separate the iron from the slag without destroying its identity. Thus it would be impossible to remove the slag from wrought iron without a melting process which would change its nature since puddled iron has never been in a molten state, and it would be just as impossible to introduce slag into pure iron without some such similar treatment.

The very structure of wrought iron, however, offers a means of testing, to a certain extent, these two theories without disturbing the relation of slag and iron or changing the nature of either. This structure is shown clearly in Fig. 1 and Fig. 2—a longitudinal and a transverse section respectively in which the slag inclusions appear as dark lines in the former and as dots in the latter. It is easily seen that in one direction, namely, perpendicular to the slag layers, the metal is not continuous and any oxidation of the metal as it penetrates inwardly from the surface must meet layers of slag. In the other direction, however, that is, in a direction parallel to the layers of slag, the metal is continuous and as it penetrates will not meet these layers of slag or cinder. Hence, if corrosion is retarded by slag inclusions, as is insisted upon by the adherents of the physical structure theory, one would expect to find that transverse sections of wrought iron will rust more rapidly than longitudinal sections. On the other hand, if the two sections corrode at the same rate we may conclude that as far as producing any physical obstruction to corrosion is concerned, the

† A paper presented at the Boston Meeting of the American Electro-Chemical Society, April 8-10, 1920.

slag is inert and that any property of resisting corrosion that wrought iron may possess is not due to slag barriers but the purity of the metal or to some other cause.

In order to test out this line of reasoning, transverse and longitudinal sections about 1/16 inch in thickness were taken from pieces of Swedish iron and wrought iron and subjected to rusting at different times. The pieces were thoroughly annealed and the surface made smooth with emery cloth. After weighing and measuring the thickness of each piece in several places, all were placed in a wooden rack, as shown in Fig. 3, and exposed to the weather as follows:

Wrought iron (A and B)......1 year
Swedish iron..................6 months
Wrought iron (C).............2 years

The analysis of the different irons, the exposure data and the results are given in Table I and Table II.

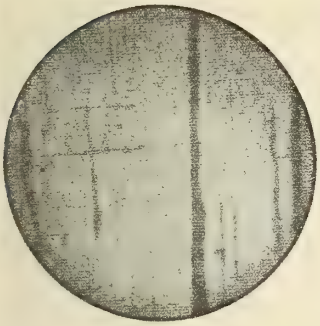


Fig. 1.

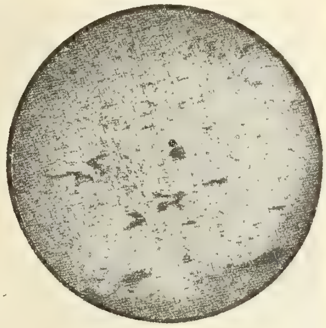


Fig. 2.

Figs. 1 and 2.

Table I.

	Sulphur	Phosphorus	Carbon	Manganese	Silicon	Copper
Steel	0.032	0.079	0.08	0.56	.....	none
Wrought Iron (A)	0.044	0.132	0.015	0.095	0.193	none
Wrought Iron (B)	0.020	0.100	0.020	0.038	0.180	none
Swedish Iron	0.015	0.052	0.015	0.011	0.050	none
Wrought Iron (C)	0.026	0.115	0.04	0.05	0.210	0.10

Table II.

	Time Exposed	Transverse Section Loss in Weight	Transverse Section Depth Pits	Longitudinal Section Loss in Weight	Longitudinal Section Depth Pits
Steel					
Wrought Iron (A)	6 mos.	0.1178	0.035	0.1101	0.033
Wrought Iron (B)	2 mos.	0.0791	0.044	0.0789	0.041
Swedish Iron	6 mos.	0.1068	0.026	0.1333	0.026
Wrought Iron (C)	2 years	0.153	0.020	0.154	0.025

In the above table the loss in weight is in grams per square centimeter and was obtained by cleaning the rusted specimens with a solution of ammonium citrate. The depth of pits was obtained by grinding the surface of the cleaned specimens until the pits on the surface were removed.

It is evident from these figures that the amount of total corrosion as given by the loss in weight, as well as the extent of localized corrosion as indicated by the depth of pits, is the same in both transverse and longitudinal sections within the limits encountered in corrosion work.

In order to determine definitely, however, that the slag inclusions offerred little resistance to corrosion, it was necessary to show that corrosion actually penetrated layers of slag. To settle this point sections were made of the iron test pieces and examined with the microscope. A representative section is shown by Figs. 1 and 2 which are photographs that include an area 1.5 millimeters in diameter. Since in some cases corrosion had penetrated 0.35 to 0.44 millimeter, it is evident that several layers of slag had been penetrated.

In addition to these data, sections of the specimens have been carefully examined with a microscope and in no case has any visible evidence been found of slag inclusions hindering the progress of corrosion. Likewise, an examination of the corroded surfaces of a

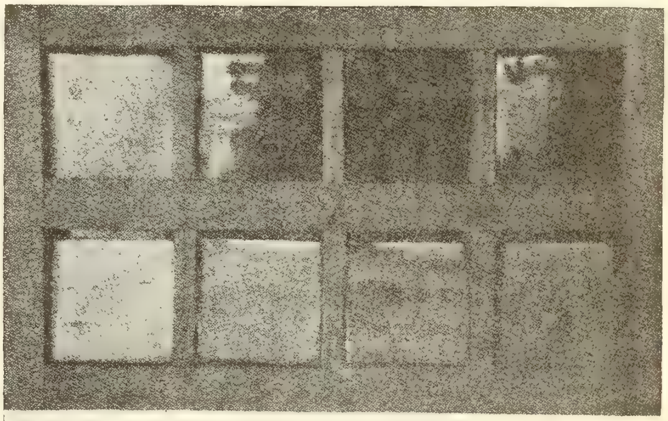


Fig. 3.

number of old irons that have been exposed to corrosion for ten to thirty years, failed to show any evidence of slag in wrought iron retarding the progress of corrosion.

In view of the fact that the corrosion of transverse and longitudinal sections is the same as regards loss in weight and depth of pits, the conclusion has been reached that any superior resistance to corrosion that wrought iron may have is not due to slag inclusions but to some other cause, among which may be mentioned the purity of the iron. Furthermore it is our experience that the "pure irons" on the market are very similar to wrought iron in their resistance to corrosion. This would also tend to confirm the above observation.

BURNETT & CRAMPTON TAKE OVER MAISONNEUVE FOUNDRY.

Burnett & Crampton whose foundry at Rigaud, Que., was recently totally destroyed by fire have bought the Maisonneuve foundry, 860 Lasalle Avenue, Montreal. They advise us that they contemplate making considerable extensions and alterations to this foundry to enable them to cast daily between 15 and 20 tons of general machinery castings. They will continue their policy of specializing in high class work.

FOUNDRY AND MACHINE SHOP PRODUCTS, 1918

The Dominion Bureau of Statistics has completed a preliminary survey of the production in foundries and machine shops in Canada for the calendar year 1918. The report covers the operations of 667 individual plants, distributed by location in the following order: Ontario 369 plants, Quebec 126, British Columbia 69, Saskatchewan 25, Nova Scotia 23, Manitoba, 23, Alberta 15, New Brunswick 13 and Prince Edward Island 4.

Capital Invested in the Industry.

The total capital invested in the industry in the Dominion in 1918 was $84,122,446. The various items comprised in this total were:—land, buildings and fixtures $23,151,316; machinery and tools $18,778,111; materials, on hand, stocks in process, finished products, fuel and miscellaneous supplies $23,370,603, and cash, trading and operating accounts and bills receivable $18,822,416. Distributed by provinces, Ontario leads with $56,880,631, Quebec is next with $14,276,674, the other provinces following in the order named:—British Columbia $3,635,563, Manitoba $2,781,536, New Brunswick $2,623,056, Nova Scotia $2,007,191, Alberta $1,176,932, Saskatchewan $508,423 and Prince Edward Island $232,440.

Employees Salaries and Wages.

The number of persons in the industry classified by employment and by sex together with the amounts paid each class in salaries and wages are given in the following summary table:

Classes of employment	No. of employees Male	Female	Salaries and Wages
Officers, superintendents and managers	868	16	2,279,872
Clerks, stenographers and other salaried employees	1,358	635	2,171,410
Wage earners, average number	22,960	619	24,509,092
Outside piece-workers	26	.....	25,932
Totals	25,212	1,270	$28,986,306

The number of persons receiving weekly wages by specified groups, as at December 15th, was:—Under $5 per week 275; from $5 to under $10 per week, 1,502; from $10 per week to under $15 per week, 2,928; from $15 to under $20 per week, 4,907; from $20 to under $25 per week, 5,374, and over $25 per week, 6,083.

Fuel and Miscellaneous Expenses.

Fuel Consumption.—The total cost of all fuel used during the year was $2,654,146 of which $619,895 was of Canadian origin and $2,034,251 of foreign origin. Coal consumed amounted to 137,688 tons worth $1,199,417; coke to 76,320 tons worth $907,139; gasoline, 153,280 gallons worth $36,718; fuel oils 2,900,072 gallons worth $343,964; gas, artificial and natural, 291,051 m. cubic feet worth $108,142 and all other fuel, value only, $58,766.

Miscellaneous expenses.—The total charge for miscellaneous expenses for the year was $8,553,509, itemized as:—rent of offices, etc., $277,666; rent of power $557,757; insurance premiums $577,536; taxes, internal revenue, war, etc., $425,812; taxes, provincial, municipal, etc., $397,797; royalties, use of patents, etc., $97,162; advertising expenses $330,698; travelling expenses $434,085; ordinary repairs to buildings and machinery $1,478,006, and all other sundry expenses $3,976,990.

Materials used.

The cost value at the works of all materials used in the year was $27,788,059, the principal items being given by quantities and values in the following table:

Kinds of materials	Quantity Tons	Cost value at works
Pig and scrap iron	22,182	9,100,807
Bar and sheet iron	6,893	612,335
Black and galvanized iron	5,751	759,780
Malleable and wrought iron	3,303	275,503
Iron castings purchased	10,305	1,289,892
Sheet, plate and tool steels	13,550	1,929,016
Steel bars, billets and other shapes	23,416	3,636,480
Steel castings, purchased	2,020	299,442
Brass castings, purchased	593	307,978
Brass sheets and bars	565	312,697
Bronze castings	318	214,874
Tin sheet and pig	1,127	269,557
Copper bar, sheet, pig, etc.	476	255,924
Other metals in any shape or form	1,931	509,211
All other miscellaneous materials		7,914,563
Total cost		$27,788,059

Products of the Industry.

The selling value at the works of all products made and work done during the year was $82,493,897. The principal products are given in the following table by quantities and values wherever available:—

Classes of products	Unit	Quantity	Selling value at works
Grey and malleable iron castings	ton	30,665	12,588,988
Brass and copper castings	ton	6,435	856,633
All other castings, not specified		....	904,750
Stoves, oil, coal, gas, electric and wood	No.	350,055	6,024,473
Furnaces, hot air	No.	13,782	1,117,832
Ventilating appliances	No.	12,110	324,511
Furnaces, hot water, etc		....	702,926
Radiators and parts		....	1,536,073
Stove and furnace parts		....	717,980
Grate bars	N .	80,286	158,456
Hot air registers and grills	No.	75,211	111,037
Machinery of all kinds		....	8,066,455
Tools all kinds		....	1,536,267
Tinware		....	1,496,115
Munitions		....	7,703,838
Boilers and engines		....	3,660,168
Car wheels		....	2,028,975
Foundry supplies		....	4,140,795
Miscellaneous products		....	21,020,892
Custom work and machinery repairs		....	7,796,732
Total value			$82,493 897

OBITUARY.

The late William H. Frost.

The death took place at Smith's Falls on March 18th of one of that town's leading citizens in the person of William H. Frost, President of the Smith's Falls Malleable Castings Company, Limited, and the oldest malleable casting manufacturer in Ontario. Deceased was in his seventy-third year. He started business in Smith's Falls in a small way in 1878 and under his direction and control the business grew to be one of the leading industries of the kind in Ontario. Two plants are being operated at the present time. Two brothers of the deceased were the heads of the Frost & Woods Company and the family has played a leading part in the commercial development of their native town.

CANADA A SHIP OWNING NATION

By COLIN McKAY in "Shipping," New York

In the hard old days when steamers were regarded by deepwater seamen as graceless interlopers upon the seas, impudently plunging into the eye of the winds, trailing their defiling smoke across the splendour of the skies, Canada was fourth among the ship-owning nations of the world; her Maritime Provinces owned more shipping in proportion to population than any other country, and their flocks of white-winged clipspers furrowed all the seas. "Bluenose" ships were then celebrated for their smartness, and "Bluenose" masters and mates had a reputation for ruthless efficiency which was spread by grim yarns by sailormen in all the ports. Hard packets to sail in were these Bluenose ships, for their masters and mates were hard-bit men, hard drivers of ships and men, and they enforced a fierce efficiency, an iron discipline, with doubled fist and heavy boot and ready belaying pin. Save for young men from their home ports few but seasoned seamen willingly shipped aboard a Bluenose, and for many crews were only obtainable in far ports by the way of drugged liquor and shanghaiing in the dark of night.

In those days there were wooden shipyards in nearly every port in Maritime Provinces and Quebec, and building ships and sailing them were occupations held in honor by the people. Often the builders and owners and masters made money, and there are many families around the coast whose fortunes were founded years ago by ships that made good ventures to the Spanish Main and ports in far off corners of the earth. And many of these builders and sailors of Bluenose ships went to the United States, then a country of greater opportunities and richer rewards. Among the shipbuilders who were to find fame and fortune in the United States was Donald McKay, whom Basil Lubock, the English writer, has called the greatest builedr of sailing ships. McKay built ships at Jordan River, Shelborne County, Nova Scotia, before he went to East Boston, Mass., to establish the yard that turned out the swiftest of the famous American clipper ships of the middle of the last century. The Nova Scotian, whose family came from Inverness-shire, Scotland, built many of the clippers whose performances are still the subject of long yarns among sailormen the world over. Among the McKay clippers was the "Sovereign of the Seas," whose performances have never been equalled by anything under sail. This fine ship made some of her most remarkable voyages while commanded by Laughlin McKay, a brother of the builder, who served his time aboard Bluenose ships before he sailed under the American flag. Once her noon to noon run was 437 knots. Another famous McKay clipper was the Flying Cloud; her greatest day's run was 432 knots. McKay also built the Great Republic, a shipentine of 4,300 tons, then the largest ship afloat by far and the first ship to be equipped with double topsail yards, an innovation which greatly lightened the labors of sailors.

The Canadian shipbuilding and shipowning industry was at its height when theSuez Canal was opened, but from then on it began to decline, for the Suez Canal caused a revolution in the trade of the world and enabled the steamship to capture the profitable traffic and drive her white-winged rivals into trades that became less and less lucrative. When the great war broke out—though Canada was building steel ships on the Great Lakes—she had only a few, small yards on the Atlantic coast engaged in building fishing vessels and tern schooners for the West Indian, Newfounland and South American trades. But presently the Imperial Munitions Board began to let contracts for the construction of ships in Canada, and up to the spring of 1918 this body awarded contracts for 42 steel steamers, aggregating 207,800 tons deadweight, and 42 wooden steamships, aggregating 129,360 tons deadweight. Most of the steel vessels were built on the Great Lakes, or on the St. Lawrence, only two being built in Nova Scotia. The wooden steamers were built at Vancouver, Victoria, on the Great Lakes, the St. Lawrence and at St. John, N. B. During the first three or four years of the war Canadian yards built quite a lot of wooden steamers of about 3,000 tons for foreign governments, principally France. The Foundation Company of Victoria, B. C. alone built twenty of these vessels for foreign account. Shipbuilders were then prohibited from building steel ships for foreign account.

When the Union Government was formed Col. Ballantyne, a big business man, became Minister of Marine, and one of the first things he did was to propose the question, Why shouldn't Canada build ships for herself instead for other countries? And he managed to prevail upon the Government to inaugurate the programme of building a national merchantile marine; following the policy of the sister Dominion of Australia, which had already acquired a considerable national fleet by purchase. The Minister secured an appropriation of $70,000,000 from Parliament, and in March, 1918, awarded the first contract to the Canadian Vickers, Limited, of Montreal for freighters of 4,300 tons deadweight, price per ton being $207. Altogether the Government has let contracts for 58 cargo steamers, ranging from 3,300 to 11,300 tons. Up to the present 23 have been launched, and most of these are in commission carrying Canadian products to the West Indies, South America, Great Britain and other countries. The first of this fleet was launched in November, 1918, from the Vicker's yard at Montreal. She is called the Canadian Voyageur, and is now running between London and Halifax. All the ships of the Canadian Government Merchant Marine have the prefix of Canadian before their names. The general manager is Mr. Teakle, formerly of the Allan Line, and his headquarters are at Montreal.

At the present time the Canadian shipbuilding industry represents an investment of $50,000,000, and it estimated that it gives employment to about 25,000 men in the yards, and another 25,000 men engaged in the manufacture of marine equipment and supplies. In addition to ships built for Canadian register Canadian shipyards during the last calendar year turned out eighty vessels which were sold to other countries; of these sixty were wooden steamers with a total net tonnage of 68,522; eighteen were steel steamers with anet tonnage of 30,071; and two were wooden sailing vessels.

Before the armistice the Canadian Government placed orders for 45 steel steamers at an average cost of $199.63 per ton; and the balance of the orders at $173.17 per ton. The average cost of the Government fleet when completed will be $193 per ton. The British Government had 44 ships built in Canada at an

average cost of £39 10s., or about $190 per ton. During the war the British Government bought 13 ships from the United States at £45 7s. per ton; 17 from Japan at £44 17s., 11 from Hongkong at £33. It is said that before the war vessels of a similar class should have been built in Great Britain for from £5 to £7 per ton.

Whether the Canadian shipbuilding industry, built up during the war will continue, depends largely no doubt on the continuance of Government assistance in some form. Pressure is being brought to bear upon the Government to induce it to award more contracts; on the other hand there are interests urging the Government to sell its ships and get out of the ship-operating business. At present the national ships are making money. The Minister of Marine stated not long ago that some of them have already paid for themeselves. Whether the Government will do so well when it has all its ships in commission, and the increasing competition begins to affect freight rates is another matter. The Minister of Marine is talking of building 15,000-ton liners to carry passengers as well as cargo, but Sir George Foster, the acting Premier has rather poured cold water on this project, and it is hardly likely to develop any enthusiasm, especially as the C. P. R. is building 20 knot liners of 22,000 tons. The Government is hardly likely to order any more ships for the national fleet of cargo carriers, and this seems to be the view of the ship builders. At any rate they are now urging the Government to grant bonuses of ten dollars or so per ton on the construction of ships that conform to certain standards., and to loan money on easy terms. It is reported that the Government has offered to aid the shipbuilding industry of British Columbia by loaning 75 per cent of the capital cost of wooden ships built there. And it is probable that the Government will offer a bonus to encourage the steel shipbuilders.

Up to the present Canada has had to import most of its steel plates from the United States, but the Dominion Steel Company, has under contract with the Government, just completed a $5,000,000 steel plate rolling mill at Sydney, and has undertaken to supply 50,000 tons of ship's steel annually for a period of five years, subject to the orders of the Canadian Government. No doubt the Government will try to have this steel utilized in Canada, and the building of this mill may have been in preparation for the construction of a Canadian navy. Lord Jellicoe was recently in Canada, having been invited there tó confer with the Government in regard to its naval policy. In this connection it is interesting to note that a group of British shipping magnates, including Viscount Furness, Sir William Beardmore of Glasgow, Sir Trevors Dawson, vice-chairman of Vickers, Ltd., and Benjamin Talbot, of the Cargo Fleet Coporation, have recently acquired heavy interests in the Dominion Steel Corporation. It is suggested that they are planning to start shipbuilding enterprises in Canada with a weather eye on the chance of securing contracts to build ships for the Canadian navy. But there is another aspect of the question. The Financial Times of Montreal says that the British Government directly or indirectly is interested in the plans of the British magnates to secure control of the Dominion Steel Corporation, in order to assure the utilization of its extensive iron ore and coal supplies within the Empire.

Be that as it may, Canada may be expected to make every effort on her own account to maintain her shipyards in operation and develop them, and to become, as she was years ago, an important shipowning and ship-operating nation. The Halifax Shipyards, Ltd., has just announced plans for an increased number of building slips, capable of constructing larger ships than have been built in this country heretofore; and its agents are now in Europe trying to secure one of the twenty-thousand-ton floating dry docks, which Germany has surrendered to the Allies. At St. John, New Brunswick, a dry dock 1,250 long will be complete next year, and large sums are being spent on harbor construction at Montreal, Quebec, Vancouver, Halifax and St. John. Montreal is now the second port on the continent, and Canada's foreign trade has been literally growing by leaps and bounds. Her exports of farm products have double in a few years, and there is an increasing demand for her forest products, her coal and iron and other natural resources. Her manufacturing industries are at present swamped with orders, and export in may lines is only permitted under government license, in order that her home markets may not be denuded of supplies.

In accordance with her general policy Canada will try to carry on her foreign trade in future in Canadian ships, built in Canadian yards.

OFFICERS AND OBJECTS OF THE ONTARIO MINING ASSOCIATION.

An organization to be known as "The Ontario Mining Association" was effected in Toronto on March 9th, 1920.

The object of the association will be to foster the development of the industry and to co-operate with the Mines Department of the Ontario and Dominion Governments.

By collecting and consolidating data and statistics relating to the industry the Association will be in a position to supply authoritative information hitherto unavailable in the hope that the people of Ontario may gain a more reasonable and keener appreciation of the importance and problems of the industry.

The following is a list of the Officers and Directors:

President: A. D. Miles, Toronto; 1st Vice-President: A. F. Brigham, Porcupine; 2nd Vice-President: Col. R. W. Leonard, St. Catharines; Directors: C. W. Corless, Sudbury; C. D. Kaeding, Porcupine; H. H. Kee, Cobalt; H. Park, Cobalt; F. L. Culver, Kirkland Lake; Mr. Cowie, Sault Ste. Marie; W. A. Carlyle, Ottawa; G. H. Gillespie, Madoc; A. J. Young, Toronto; G. C. Bateman, Toronto; J. P. Bickell, Toronto, Alex. Fasken, Toronto; Secretary-Treasurer: B. Neilly, Toronto.

These Directors represent the following branches of the Mining Industry:

(1) Porcupine, Kirkland Lake and Boston Creek gold districts.

(2) Cobalt and Gowganda silver district.

(3) Nickel, Copper Mining, Smelting and Refining Industry.

(4) Iron and Sulphur Ore Mining..

(5) Silver smelting industry.

(6) Non-metallic production from Eastern Ontario.

Practically all producing mines, as well as a large proportion of the more important properties under development in the Province, are already members of the Association, making it apparent that the Ontario Mining Association will represent the Mining Industry as a whole.

A permanent office is being established in Toronto.

LEGISLATION PRESCRIBING THE STATUS AND PRACTICE OF ENGINEERS

In this issue will be found a prècis of a draft act, now before the British Columbia Legislature, the short title of which is cited as the "Engineering Profession Act." The draft act is the result of consultation between technical societies in British Columbia, and is understood to have been amended in accordance with representations made by members of the Canadian Mining Institute resident in British Columbia.

The specification of the practice of a professional engineer by the Act is very comprehensive, including as it does, the civil, railway, hydraulic, steamship, electric, sanitary, mining, metallurgical and chemical engineer; the "development of rocks, minerals (including coal, petroleum, natural gas, and other fluid substances of value)," and "all other engineering works." Definition of "engineering work" savors of an attempt to set bounds to the infinite. If "engineering" as it is sketched in the interpretation clause of the draft act does not comprehend the entire sum of human knowledge, it goes more than halfway. Take for example the phrase: "Investigation relating to the "examination, surveying, exploration and development "ment of rocks, minerals, rock structures, geological "processes and the application of geology to practi-"cal problems of the industries, arts and engineering." In this all-comprehending phrase there must be included the prospector, the ordinary mining engineer, the chemist, the metallurgist, the mineralogist, the petrologist, the paleobotanist, the paleontologist, and speculative and practising geologist in all his infinite variety.

Frankly, we do not believe that legislation of this comprehensive, and therefore necessarily unspecific character, can be enforced in practice. The powers which would reside in the Council of a Professional Association such as the Act proposes would be immense, but very indefinite. Because of the wide sweep of distinct professions which the Act attempts to take in under the generic term "engineering," the powers given to the proposed Association would be much wider, and not comparable with those given to professional associations such as control the medical, dental and similar professions. In these cases, the limits of professional qualifications are nicely and exactly drawn, but what chiefly recommends the conference of special powers upon the professions of which the medical profession is the best example is that they deal in matters of health, extending almost to powers of life and death. In the case of engineers—using the wide-open definition of the draft Act, it cannot be urged that matter of public health, or the preservation of human life, are so intimately concerned. Where the public safety is touched in engineering performance and design, the existing laws contain all that is necessary, inasmuch as the safety of bridges, dams, factories, ships, electric transmission and grain elevators are all most carefully provided for in public regulations of long standing. In the case of mining, statutory regulations exist in every province, providing for the safety of appliances and requiring certification of the competency of mine officials. In questions of public safety, therefore, the functions of a Professional Association such as is suggested by this draft Aca, would duplicate public statutes of great variety and long establishment.

As concerns the expenditure of public and private monies, the situation is different. It is well known that much money has been foolishly expended through incompetent direction, but is this a question that permits of statutory regulation? To attempt it trenches upon sumptuary legislation, and, no matter what statutes are enacted, he that pays the piper will always call the tune.

The objects of the Association proposed—that is to say, the attainable objects—therefore resolve themselves into the raising of the status of the "engineer," or in other words, a desire to secure his more definite recognition by the public, and to raise his emoluments. This is understandable, and, within proper limits a laudable aim.

It is, however, open to the gravest question whether compulsory regulation by statute is the best manner in which to effect the aim mentioned, with which aim, we desire to emphasise, no fault can be found. The question is, nevertheless an open one.

We would suggest, however, that there is no question as to the unwisdom of attempting to regulate the engineering profession under an interpretation so wide, and at the same time, so impractically indefinite as that prescribed in the British Columbia Act.

When the Act was introduced into the British Columbia Legislature, after having had a stormy passage through the Private Bills Committee, it met the severest criticism from Premier Oliver, and Mr. J. H. Schofield, the Member for Trail, B. C. Mr. Schofield said the Act was bitterly opposed by propectors, miners and smeltermen. The Premier expressed his most determined opposition to the Act, as drafted, basing his viewpoint on the belief that practically trained men had often succeeded where scientifically trained men had not. Mr. Anderson, who introduced the Act, said the text did not warrant the construction put upon it by the Premier.

This reception is probably typical of the criticism that will be levelled against any legislation seeking to enforce a close corporation for "engineers," and it is significant that the criticism levelled against the draft act was based upon its wide interpretation of what constituted engineering practice.

We believe the formation of an association of professional engineers, such as is proposed by the draft act under discussion is unworkable because of the fundamentally erroneous conception of the possibility of comprising within the scope of one incorporated body all the ramifications of the activities of the engineer. We also believe that this conception, if persisted in, will limit the usefulness of the engineer by attempting to set bounds to the boundaries.

It is suggested that the manner in which the engineer can gain that public recognition which is his undoubted right is through the strengthening of existing professional societies, each functioning within the limits of his own specialized activities. When our professional societies have so arranged their own internal affairs as to be able to place upon their members the stamp of professional competence and rectitude, and to discipline unworthy members; and have educated the public to accept the society stamp as a guarantee of those things that are desirable in an engineer, then, and not till then, have our societies any right to ask governments to attempt that which, so far, our professional societies have not yet found it within their ability to compass.

PRECIS OF PRELIMINARY DRAFT OF PROPOSED BILL RESPECTING THE ENGINEERING PROFESSION BEFORE THE BRITISH COLUMBIA LEGISLATURE.

Interpretation: The practice of a Professional Engineer Within the Meaning of this Act.

"(b) The praciee of a Professional Engineer within "the meaning of this Act embraces advising on, re- "porting on, valuation, laying out and the design, "carrying out, direction of the construction, install- "ation, improvements of public utilities, factories, in- "dustrial works, railways, bridges, tunnels, highways, "roads, canals, harbours, harbour works, river im- "provements, light-houses, wet docks, dry docks, "dredges, cranes, floating docks, ship design and con- "struction and other similar works, steam engines, "turbines, pumps, internal combustion engines, and "other similar mechanical structures, air ships and "aeroplanes, electrical machinery and apparatus, "chemical operations, processes, apparatus, and ma- "chinery, and works for the devolopment, transmis- "sion or application of power, light and heat, launch "ways, marine ways, grain elevators, municipal "works, irrigation works, water works, water purific- "ation plants, sewerage works, sewage disposal warks, "drainage works, incinerators, hydraulic works, min- "ing properties, mining operatios, mining and con- "centrating machinery and apparatus, mine and con- "centrator buildings and structures, oil and gas wells, "mineral deposits, metallurgical works, metallurgical "proceses machinery and equipment, metallurgical "buildings and structures, investigations relating to "the examination, surveying, exploration and develop- "ment of rocks, minerals (including coal, petroleum, "natural gas, and other fliud substances of value), "rock structures, geological processes and the applic- "ation of geology to practical problems of the indus- "tries, arts and engineering, and all other engineer- "ing works, and all buildings necessary to the proper "housing, installation and operation of the Engineer- "ing works embraced in this section.

"The execution as a Contractor of work designed "by a Professional Engineer, the supervision or the con- "struction of work as a foreman or superintendent "or as an inspector, or as a roadmaster, trackmaster, "bridge or building master, or superintendent of main- "tenance shall not be deemed to be the practice of a "Professional Engineer within the meaning of this "Act."

Provision for a Close Corporation.

All persons registered as Professional Engineers under this Act, shall constitute the Association of Professional Engineers of the Province of British Columbia, and shall be a body politic and corporate, with perpetual succession and common.

Association is given power to hold real estate, within specified limits, to pass by-laws not conflicting with the Act for governance, discipline, admission, etc.

Who May Practice.

Only such persons as hold membership in the Association, or license from the Association to practice. Persons having five years previous practice as a professional engineer under the definition of the Act, and residing in British Columbia at the date of the passing of the Act. Provision is made to permit persons to practice who come from other provinces of Canada, who fulfill specifications of membership and pay the prescribed fees. The Act does not apply to government employees. Engineers who have been overseas are given full rights of members of the Association.

A provision which it is understood has been asked by representatives of the Canadian Mining Institute, reads as follows:

"Notwithstanding anything to the contrary in the "Act, any person who is not a resident of British Co- "lumbia may practise without license in the Province "for the purpose only of examining of, consulting on, "advising on and reporting on properties and works "in the said Province, in the interests of persons who "are not residing in British Columbia. Such persons "may also superintend operations, directly resulting "under this Clause, for one continuous period of not "exceeding three months, without license, provided "that this privilege of superintendence shall not be "permitted more than once in connection with such "operations."

Powers of the Association.

The Act provides the form of corporate organization and specifies the officers to be appointed Powers are given to expel members for unprofessional conduct, negligence, or misconduct, or for commission of a criminal offence if convicted by a competent Court. Rules of evidence and procedure are specified. Penalties are prescribed for persons practising as a professional engineer without license.

Provision is made for admission by examination, all of which is given to the discretion of the Council of the association. Provision is also made for joint action in these matters with other Councils of professional associations in other provinces of Canada. The names of licensed engineers will be recorded on a Register, and duly gazetted in the "British Columbia Gazette."

No person may be registered until he is 23 years of age, and has been engaged for eight years in some branch of engineering, except in the case of a graduate of a recognized engineering college, in which case the period is reduced to six years, which may include the term of instruction.

Provision is made for appeal to a Judge of the Supreme Court against refusal by the Council to issue a license to practice.

Within three months of the passage of the Act the Lieutenant-Governor-in-Council shall appoint a provisional Council of the Association consisting of eleven members, who shall elect their own officers.

REJECT 10 PER CENT RAISE

A meeting of eight hundred mechanics from the Dominion Shipbuilding Company was held in Toronto on Saturday, April 3rd, to hear the report of their negotiating committee. The ten per cent increase offered by the company was rejected by the men, and at the request of the company the committee will reopen negotiations.

NEW STEEL INCORPORATION

To carry on the business of iron masters, steel makers, steel converting, etc., the British Empire Steel Corporation, Limited, has been granted incorporation by the Federal Government. The company has an authroized capital of $100,000 and the chief place of business is at Montreal. Among the incorporators are R. G. Grant, accountant, and F. H. Market, W. W. Skinner and G. G. Hyde, barristers.

NOVA SCOTIA ACCIDENT PREVENTION ASSOCIATION

The Workmen's Compensation Act of Nova Scotia provides that an association of employers for the prevention of accidents may be formed under the auspieces of the Compensation Board, and that such rules as may be decided upon by the Association for the purpose of preventing accidents, shall, if approved by the Board, become compulsory upon employers in the Province.

An organizing meeting was held last year, and recently the first annual meeting of the Association was held in Halifax.

The newly elected officers of the Association are as follows:—

President: George D. Macdougall, General Superintendent, Nova Scotia Steel & Coal Co., New Glasgow.

1st Vice-President: F. E. Lucas, Economy Engineer, Dominion Steel Corporation, Sydney.

2nd Vice-President: J. E. Lucas, the Halifax Shipyards, Ltd., Halifax.

Secretady-Treasurer: H. B. Thompson.

An Executive Committee is composed of the Chairmen of the respective trade sections, these being as follows:—

Mining, A. J. Tonge, General Supt., Dominion Coal Co.,; Lumbering and Woodworking, R. E. Dickie; Metal Trades, R. B. Stewart, Maritime Bridge Co.,, New Glasgow; Building Construction, A. S. Curry, Rhodes Curry, Ltd., Amherst; Public Utilities, J. H. Winfield, President, Maritime Telephone Co.; Transportation and Navigation, G. W. C. Hensley, Pickford and Black, Halifax; Miscellaneous, C. V. Managhan, Moirs Ltd., Halifax.

The meeting was addressed by the past-President, Mr. C. D. Dennis, Rhodes Curry Ltd., who described the organizing meeting held last April and outlined some of the difficulties which it had been necessary to overcome in commencing the work of the Association. Mr. A. F. Lucas then addressed the meeting, and was followed by Mr. F. W. Armstrong, Vice-Chairman of the Compensation Board, and Mr. John Mackeigan, auditor, who explained the financial position of the Board, and outlined the manner in which it was hoped the Association would be able to assist the Board in controlling and reducing accidents and the assessments.

As all the officers of the Association are men who hold responsible positions of superintendence in the main divisions of industry comprised within the scope of the Compensation Act in Nova Scotia, it may be anticipated that such regulations as may commend themselves to the Association will be enforced. The Association will also form a nucleus and a directing force for first-aid work, "safety-first" meetings, and similar activities that have had such excellent results in the reduction of the accident rate in other industrial communities. Nova Scotia is to be congratulated on the formation of this Accident Prevention Association, and on the personnel of the officers.

GEORGE D. MACDOUGALL.

THOS. McAVITY & SONS, LTD., ST. JOHN, N. B.

A record of eighty-five years in business in hardware and ironmongery would be difficult to excel in Canada, but this is the history of the well-known firm of Thos. McAvity & Sons of St. John, New Brunswick, whose origin and present day importance is reviewed in a brochure received by "Iron and Steel." The martial learnings of the McAvitys is well-known in the Maritime Provinces, where the family have always been prominent in Militia affairs. The firm was represented in the war by Lt. Col. T. M. McAvity, D.S.O., Major Roland A. McAvity, Major Percy D. McAvity, and Segt. Thos. A. McAvity, and by 154 employees. A striking reminiscence of war times, and of the extent to which the McAvity firm assisted in the manufacture of munitions is a photograph of over 200,000 rough forgings of 9.2 shell cases in the McAvity yard, awaiting machining.

The McAvity Company employs in its various branches over 2,500 persons, and its products, used in the mining, shipping, pulp and railway industries of Canada, are well-known, and possess a recognized standard of excellence. As makers of valves, McAvity's mark is known all over the world. Messrs. McAvity & Sons are to be congratulated on their long record of honourable business in St. John, where, as it is correctly stated in the brochure, the advancement of the firm has been coincident with the progress of business in the Maritime Provinces.

MR. RICHARD BROWN, M. E.—1805-1882.
MR. RICHARD HENRY BROWN, M.E. — 1838-1920.

An Appreciation by THOS. J. BROWN, Sydney Mines, Nova Scotia.

On the 9th day of February in this year, at his home in Halifax, after a few hours illness, died Mr. Richard Henry Brown, at the age of 82 years. The names of Mr. Brown and his father, Mr. Richard Brown, have been so long and so creditably associated with coal mining and its kindred interests in this province, it is appropriate that your paper should record these few appreciatory remarks. It is a very remarkable fact that these two gentlemen, father and son, should have had control of the affairs of the principal, and at one time, the only company engaged in the mining of coal in this province, for the extraordinary span of 74 years, and it is also a remarkable coincidence that each gentleman served exactly the same length of time, 37 years.

The father, Mr. Richard Brown, F.G.S., F.R.G.S., was born at Lowther, Cumberlandshire, England, on May 2, 1805, and came to Cape Breton as the agent of the General Mining Association of London in the year 1827. In June of the year 1864 he resigned the position of agent and manager in favor of his son Richard Henry, and returned to London, England, where he died on the 30th of October 1882.

Mr. Brown, aside from being a practical mining engineer and expert, was a great student of geology and history and was closely identified with such noted authorities as Sir Charles Lyell and Sir William Dawson, the two famous geologists of those days. He added many valuable papers to the engineering and geological literature of his time and some rare geological specimens and fossil remains were through his efforts supplied, and added to the English and Canadian collections. As the result of his geological research work in Cape Breton, he wrote a "History of the Coal Trade of the Island of Cape Breton," a book filled with the most accurate information which is still used as a reference book on the subject, and those who have occasion to refer to the book are amazed at the amount and the accuracy of the information it contains, particularly when it is remembered that the information about the outcrops, thickness and quality of the various coal seams was collected when the country was a wilderness and the means of travel very limited. The attention he gave to a study of the Island's history, the attachment he had for the place of his adoption, the interest he manifested in the youth of Cape Breton, caused him to write a "History of the Island of Cape Breton." This he did after his retirement to England, and the work which he dedicated to the youth of Cape Breton is an interesting and invaluable one.

He was the first man in Cape Breton to see and appreciate the value of the Island's under-sea coal measures. His faith was manifested in a decision to sink a shaft at the water's edge for the purpose of winning the coal underlying the sea. This was pioneer work, and the engineer who undertook to advise the company to sink this mine through strata filled with sea water for the purpose of mining coal under the sea, must have been an engineer of remarkable foresight and courage, and such undoubtedly was Mr. Brown. The undertaking was proceeded with, and after eight years of many difficulties and dangers, the work was completed. The Winning is what is now known as the Princess shaft of the Nova Scotia Steel and Coal Company, and has produced coal uninterruptedly from the year of its opening to the present time. To his son was left the task of completing the work. It became necessary owing to the sea breaking into it, to line the shaft with metal to keep the water back and the successful completion of this work was considered an engineering feat of considerable consequence in those days. The son was also called upon to face the problems of the extraction of coal under sea. They were many and serious, but the plans and intentions of the one were ably executed by the other, and mining engineers engaged in this field of work today willingly pay tribute to the courage and foresight of the Browns, both father and son.

Richard Henry Brown, M.E., was born in London in the year 1838. His early education was received at the Collegiate School, Windsor, N. S., and subsequently he attended the engineering department in the St. Lawrence Scientific School at Harvard University. He spent some years as a student of mining in the Seaton collieries in the north of England and served under the celebrated mining engineer, Mr. Thomas E. Forster, of Newcastle-on-Tyne. On the first of July, 1864, he succeeded his father as the agent manager of the General Mining Association in Cape Breton. In addition to the management of Sydney Mines, Mr. Brown has also the management of the Lingan and Victoria collieries, which were then operated by the Association. He continued in the management of Sydney Mines for the Association until they sold out to the Nova Scotia Steel & Coal Company, in the year 1900, and continued as manager for the new company until they got nicely underway, when he decided to retire to Halifax to spend his declining years.

The names of the Browns, both father and son, will always be associated with the coal industry of Nova Scotia. They were both remarkable men of untiring industry and unfailing integrity. Their word was their bond and they built up for the English interests they so long and ably represented in this country, a wide reputation for honesty and fair dealing.

Consistently throughout his whole lifetime, Mr. R. H. Brown was an exceptionally good living man. He had very high ideals and was scrupulously honest and upright in all his dealings. He never failed to be solicitous for, interested in and thoughtful of the sick and needy. He was notably open and honest in all his dealings and absolutely incapable of deception.

At Sydney Mines a few days ago when the many old friends of the late Mr. Brown gathered around his remains to pay him their last tribute of respect all felt they were parting with an old friend, who in his particular sphere of life had industriously striven to do his duty, and had gone to his reward leaving after him the proud record of having been a good Christian citizen, a loving, thoughful husband and parent and an honest straight-living, Godfearing man.

Note:—The Editor is very glad to publish the foregoing account of the life of the Browns of Sydney Mines, prepared by Mr. T. J. Brown, General Superintendent of the Nove Scotia Steel and Coal Company at Sydney Mines. Mr. T. J. Brown, it may be mentioned, is not a relative of the two gentlemen whose life he has detailed, although by a curious coincidence his name has continued the long tradition in the management of the Sydney Mines collieries.

THE ELIMINATION OF DEFECTS IN STEEL CASTINGS.

An exceptional number of complaints have been made of late by engineers as to the presence of defects in castings, defects whose presence cannot be detected until a certain amount of time has been spent and work done upon them.

It is notorious that since the war the quality of the work done by the average workman has deteriorated to an alarming extent, and this carelessness and slackness obtains in the moulding as in other industries. Manufacturers of castings are aware, however, that there is a percentage of defects that cannot be attributed to bad workmanship, and considerable sums have been, and are being, spent with a view to eliminating these. The president of the Birmingham Metallurgical Society a few days ago gave a detailed account of the special efforts that have been made by hydraulic and other pressure to get rid of these. The Whitworth process, as most engineers are aware, forced a hydraulic ram on the top of the ingot mould while the metal was fluid. In the Harmet process the steel was poured into a taper mould, reinforced by a series of steel rings, and the metal was gradually forced up the mould by hydraulic rams. In the Robinson process lateral compression was substituted for end-to-end compression, moulds with collapsible sides being used. From the user's point of view the latter process should be regarded with most favour, because of the possibility of the complete removal of the segregation, as it was difficult to see how any fluid compression process could in itself prevent segregation. If any such effect was produced that effect must be due to a secondary effect in the way of an increase in the rate of solidification, because of the use of heavier moulds or ingot moulds of heavier section. The presence of segregate implied lack of homogeneity, which was the cause of more trouble in the use of steel than the mere presence of relatively small quantities of impurities. Comparatively small quantities of impurities distributed with absolute uniformity would cause less trouble and have less detrimental effect on steel than a smaller quantity distributed heterogeneously.

The Talbot process utilised the principle of fluid compression by commencing rolling before the interior of the ingot had solidified. The method of producing sounder ingots by following the contraction by the addition of the supplies of liquid metal was the simpler plan and the one which had been adopted most largely. In this connection the speaker described the Hadfield-Goldsmidt process and that known as the Guthman process. The essential points in the production of sound homogeneous steel were the proper treatment of the steel by the addition of either silicon manganese or aluminium to deal with the gases, and the following-up of the contractual cavity. From the common sense point of view, there seemed no reason why this could not be done quite effectively by means of the feeder head without resorting to the costly expedient of fluid compression. From the users' point of view, the simple casting process must result in the possibility of the removal in the head of the ingot, and the removal of the segregate was probably of more importance to the user than the mere getting of the sound ingot.

The lecturer pointed out the danger in the use of aluminium as a killing agent because of the liability of the aluminium becoming converted into alumina, which gave considerable trouble on account of its highly abrasive properties.

It appears that it is no uncommon thing to find quantities of nickel, chronium and tungsten in steel supposed to be straight carbon steel, and the speaker quoted said that he had heard of brittleness in case-hardened objects being attributed to the presence of about 0.5 per cent of nickel in the steel. Other defects were due to "cold sheets" in the excessive scaling and adherence of foreign matter during rehealing, twisting during rolling operations and working at too low a temperature. Persistent brittleness is associated with the conditions of initial crystallisation and difficulties of heat treatment are often due to initial solidification having taken place under wrong conditions.

GOULAC CORE BINDER

TRADE MARK

WILL SUBSTITUTE

Dextrine, Flour, Molasses, Rosin and Compounds, ***economically*** and ***efficiently.*** One-half Goulac and one half Oil will do better work than an oil core at ***one-half*** the cost.

GOULAC WILL ***clean easy*** from the casting.

GOULAC IS A DRY POWDER and is shipped in bags.

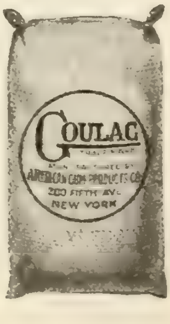
It is worth a trial in your foundry which will convince you of its merits.

We are represented in Canada by:

E. J. WOODISON CO., - - - - Toronto, Ont.
DOMINION FOUNDRY SUPPLY CO., - - Montreal, Que.

Samples and booklets on request

AMERICAN GUM PRODUCTS COMPANY



GENERAL OFFICES
200 FIFTH AVENUE
NEW YORK CITY

EDITORIAL

A Reunion of the Children of Coal

THE annals of commercial progress record that events are repeated, and that errors of intervening years are cancelled by widely separated, but persistently recurring forward steps towards an end predestined by over-riding and dominant economic laws.

The formation of the British Empire Steel Corporation is a modern instance.

A century ago, the mining of coal in Nova Scotia was commenced in a comprehensive fashion by the General Mining Association, which, between that date and the relinquishment of its lease in 1857 spent £300,000 in development. When, under popular pressure, the General Mining Association was restricted in its operations to four areas selected by its engineers, and independent operation of other areas was undertaken, the clock was put back; and, later, when the Association began bit by bit to dispose of its holdings, and became discouraged through shortsighted popular opposition, a further setback was given to the stability of coal mining in Nova Scotia.

When in 1893 the Dominion Coal Company was formed, it was but a partial reconstruction of the original edifice. It was, however, such a reconstruction as served to save the Sydney Coalfield from worse things than had befallen it through competitive and unco-ordinated exploitation, and, to the extent that it was a restoration of unified control of mining operations, it helped the industry.

The reversion of the General Mining Association's heritage at Sydney Mines fell to the Nova Scotia Steel & Coal Company, and two separate sets of mining activities were undertaken side by side in a field that is, if ever any field was, essentially one continuous coal deposit adapted for single direction—or perhaps it would be more correct to say, **demanding** single direction for the most efficient operation.

There is this to be said for the dual direction of the interwoven lease holdings of the Dominion and Scotia companies, namely, that the individual necessities of the two companies forced exploratory development that has given some valuable information — perhaps a little in advance of the information that consolidated operation would have afforded — but that is about all that can be said in defence of dual administration.

The point has now been reached when further persistence in duplicate development will represent not only so much waste of money, but actual detriment to the interest of both companies, and physical damage to the coalfield that future generations of mining engineers would regard as a singular example of folly contumaciously indulged in.

The causes that have conspired to make the undersea coalfield off Sydney Harbour a jig-saw puzzle that insults the intelligence and arouses laughter are not an edifying or a useful topic for discussion. The **fait accompli** is sufficiently lamentable, without the raising of ghosts of bygone times; and a re-allocation of the undersea areas, or a consolidation permitting single direction, was the alternative.

The four areas which the General Mining Association chose in 1857 for its own leases, with remarkable prescience, are those now operated by the Dominion Coal Company in the Sydney field and at Springhill, and those operated by the Nova Scotia Steel & Coal Company at Sydney Mines and Stellarton.

A Reconstruction of the Original Edifice.

THE union of Dominion and Scotia reconstructs the original edifice of the General Mining Association in regard to its best and largest parts, and the addition of the remaining coal companies is possibly only a matter of time.

The accretion of steel works, steel-ship building plants, transportation systems and equipment for the production of rolling stock have followed the mining of coal as they always must do, and the widespread comprehensive merging of such of these activities as have grown up around the constituent coal companies is but a reunion of the scattered children of coal.

In this reunion, "Iron and Steel of Canada" believes, lies the true and inward significance of the formation of the British Empire Steel Corporation; not forgetting, or minimising the importance of the Wabana orefield, which, as we suggested in our April issue, was doubtless the magnet that drew the attention of the new British interests, in the first instance.

Coal the Fuel of Past and Future.

THE newly constructed edifice, and it is truly an imposing one, although not fully complete in its growth, is reared upon coal, the mainspring of industry, whether we think in terms of the generation of motive power through the reciprocating steam-engine;

the gas fired boiler, steam-turbine and dynamo, or the explosion motor.

Coal was the fuel of the past, and so far as it is possible to judge (barring the discovery of how to utilize atomic energy, recently adumbrated) it will be the fuel of the future. If the motor should prove to be dominant, then the coal seams of the world promise a longer and more dependable supply of motor spirit than the petroleum wells.

It may not be amiss to recall that in the Pictou County holdings of the new corporation, which it will secure through the inclusion of the Acadia Coal Company, are oil-shale deposits of much value and unusually rich oil content.

The success of British Empire Steel Corporation will be written in the number of tons of coal it carbonizes and distills itself, or supplies to other consumers from its coal areas.

Necessity to Increase Coal Output.

THE aggregate present output of the merged coal mines is at the rate of 4¾ million tons annually, comparing with a pre-war capacity of 6¾ million tons. Possibly 97 per cent of the output capacity of the coal mines of Nova Scotia is controlled by the combining interests. The increase of the output capacity is, as may be gathered from the foregoing comparisons, the matter needing first consideration from the management of British Steel Corporation, when it shall be constituted. This will mean large expenditures in new development, machinery and housing, and, in view of the history of the past six years it will only result in disappointment if rapid and spectacular leaps in coal production are immediately looked for under consolidated management. During these years next to nothing has been spent on capital development, the working forces have suffered the wastage of war, the proportion of productive to non-productive mine labour has been destroyed and there does not now exist that differential between the wages of the shiftmen and the "face" worker that was formerly the incentive to productive work at the coal face.

Generous expenditure, intensive development, and much reorganization and recruitment of working forces must precede a return to pre-war production of coal, and it will be some years before the figures of 1913 production can be surpassed.

Reserves of Coal and Ore do not Require Over-Statement.

AS to the reserves of coal which the new corporation will hold under leases from the Province of Nova Scotia, these are sufficiently large to make over-statement an injurious superfluity, and there is no useful purpose to be served by comparing them with those of the United States Steel Corporation, which produces some 39 million tons of coal annually, and has deposits which are not comparable with the coal seams of Nova Scotia because they are so different in physical character and occurrence. In considering the coal reserves of Nova Scotia it should be remembered that they are predominatingly submarine, and that 80 per cent of the coal production of Cape Breton Island is already coming from submarine territory. There are limitations and uncertainties in undersea coal-mining that must always be allowed for.

As to the Wabana iron-ore deposit, which the new corporation will obtain in its entirety, "Iron & Steel of Canada" has already pointed out that it is "one of the most impressive reserves of iron-ore of high iron-content remaining in the temperate Zone.

Canadian Consolidation is a Measure of Necessity.

IT is to be regretted that English representatives of the London Advisory Board of the new corporation should be reported by cable as stating that the consolidation will "knock the United States Steel Corporation off its legs." Such statements are not any more accurate than they are wise. This periodical suggested some months ago that in view of the favorable decision of the United States Supreme Court towards the legality of the United States Steel Corporation a hastening of operations at Ojibway might be looked for, in which event we forecasted that the Canadian steel companies will have to compete with "the efficient forces of a "great consolidation, under unified control, a condi- "tion that will force Canadian steel interests to fall into "line with the general tendency of the time towards "self-protection by a combination of forces." Self-protection is proper and laudable, but it does not of necessity connote hostility. There is so much of this unwise and provocative talk that it is regrettable, from the Canadian point of view, to note the tendency in connection with the new corporation.

It should be emphasized that the formation of the British Empire Steel Corporation was above everything a measure of necessity and self-defence. Its first duty will be to consolidate its position, to conserve its resources, and these tasks, rather than dreams of aggression will occupy all the energies of those who are chosen to manage "British Empire Steel Corporation" for many years to come.

THE DOMINION SHIP PLATE MILL.

We publish in this issue a description of the construction and design of the 110-inch plate mill of the Dominion Steel Corporation prepared for the Toronto meeting of the Canadian Mining Institute in March, and also for submission at the recent meeting of the Mining Society of Nova Scotia in Glace Bay, by Mr. H. E. Rice, the General Superintendent of the Dominion Steel Plant.

We also reproduce, by permission of "The Electric News" a description of the electrical drive of the mill, written by Mr. H. C. Wright, of the Canadian General Electric Company who furnished the electrical equipment.

The Editor recently was courteously shown over the mill by Mr. W. G. Wilson, the Mill Superintendent, and witnessed the rolling of plates for many distant points, including Melbourne, Australia.

The striking feature of the mill as seen in operation is the small number of men required, and the flexibility and smoothness of electric operation, without which no such economy in working and exact control would be possible.

The discard from the mill is negligibly small, and the number of rejections for surface defects on the plates is less than one per cent. This satisfactory physical condition of the plates, and the manner in which they fulfill test requirements is attributed to the bottom-pouring of ingots used for rolling.

The visitor is struck by the substantial character of the mill buildings, and the room that is left for the extensions that it is expected will be required.

With the exception of a few specialists in plate-mill work, the mill was started with the assistance of local employees who had never previously seen a plate-mill, but, under the capable instruction of the Superintendent, and Mr. John Brownlee, the Head Roller, who was lent by the Homestead Liberty Mill, the local men have shown the adaptability and desire to learn that has always been a characteristic of the Cape Breton workmen, and no one watching the operations of rolling, shearing and stocking at the present time would suspect that nearly all of the workmen were quite new to the work.

The Dominion Steel Plate Mill strikes us as a satisfactory job, reflecting credit on the designers, those who constructed it, and those who are now operating it so successfully.

"WHOM THE KING DELIGHTS TO HONOR"

The presentation of the Czowski Medal at a recent meeting of the Engineering Institue of Canada to Messrs Phelps Johnson, Mr. G. H. Duggan, and George F. Porter, in recognition of their brochure on "The Design, Manufacture and Erection of the Superstructure of the Quebec Bridge" which merited the award as being the best contribution to engineering literature of the year 1919, raises some interesting considerations. The engineers who have been so rewarded by their fellows do not require the congratulations of others, but this periodical desires to commend those who made the award, and undertook, in so doing, to name the Quebec Bridge as "the greatest engineering feat of the century." The reason we venture upon these remarks is that we believe that men who achieve success in the arts of civilization should be privileged to receive the commendation of others than their fellows, and that the accomplishment of engineering work of the outstanding character of the Quebec Bridge should be signalized by honor from that source, which in our guileless and archaic fashion we believe to be the fountain of honor in the British Empire, namely the King. Either that, or Canada should provide some means by which honor can be conferred upon her eminent citizens, (other than those circumscribed—although highly prized honors—that proceed from incorporated societies with specialized scope) through which the desire of the people to honor some chosen person may be expressed.

The resolution adopted by the Canadian House of Parliament requesting the King to confer no further honors upon Canadians meant, in fact, that Canada no longer looked upon the King and his advisors as the source and fountain of public honor. That, presumably, is a course of action well within the rights of the Canadian Parliament, but the good taste, not to say anything about the wisdom of the Resolution, are open to the gravest doubt. The offensiveness of the Resolution lies, to our mind, in its essential snobbishness. The ordinance was by no means a self-denying one, for, while the average parliament of a self-governing country usually contains these men who excell in shrewdness and oratory, it is also usually singularly lacking in those men whom it has been the custom to honor by public decree from the earliest times because they have contributed to the world's progress in literature, science and the arts of civilization, of which engineering is not least. The Resolution meant, therefore, in addition to its remarkable lack of good taste, that a group of persons unlikely to be made the subjects of honor for their achievments of real and intrinsic value undertook to prevent, for ever, the expression of the desire of the Canadian people to honor a worthy citizen by the conferrence of a title.

We would also submit that the conception of the office of the Sovereign as representing any other thing than the voice of the people is contrary to British ideas the world over, and there is no other way under our present institutions by which the desire of the people to signalise worth in an individual can be accomplished except through our ancient and national custom of titular honours.

There are in Canada many men who have achieved world wide recognition of their achievments in engineering, medicine, literature, and art, but, within the conception of our legislators, these men are not worthy of any distinction above their fellows.

A recent issue of the "Atlantic Monthly" contained the life-story of a Russian Jewess, who, despite excellent wages and kind treatment decided to leave Toronto, "because of its parochial atmosphere." The parish-pump outlook is not confined to Toronto, but it is unworthy to parade such a viewpoint under the guise of democratic ideals or republican simplicity.

There are men who should be publicly honored for scientific and engineering achievments, and the erection of the Quebec Bridge is such an achievment.

It has been truly said that a prophet is not without honor, "save in his own country and among his own people."

PROPAGANDISTS OF HATE

Bolshevism is originally a reflex of the disillusion-usually possible for the discerning reader to distinguish the well-timed and recurrent contributions of the propagandist from the ordinary news of the dailies and periodical press.

It is not difficult, therefore, to detect in the unusual amount of space that the newspapers of the United States and those of the British Empire are devoting to oil occurrences and their exploitation the influence of the powerful rival groups of interests that seek the domination of the oil occurrences of the World.

There is nothing that is inherently wrong, or even novel, in this quite apparent condition, if the protagonists of the competing interests will confine themselves to proper limits of discussion. In astuteness and vision, the financiers of the United States and those of the British Empire are a fair match. They have many times in the past pitted their wits against each other, or have combined them against a common rival, as may have seemed to them at the time desirable, without rancor, and according to the ethics of the business game. All they have hitherto asked has been a fair field and no favor. Each has placed a premium on brains, and has been willing to pay good men well for services rendered.

Latterly, however, another and a less worthy spirit seems to have obtained prevalence, although it has not yet obtained predominance. This spirit is traceable to injudicious, provocative and short-sighted propaganda, emanating from private interests, but purporting to express national and racial ambitions. Strangely enough, this overdone and false expression of national aims is a product of the war. It might have been thought that the example of the Prussian, who discussed world trade in terms of military strategy, and made such an awful mess of his grandiose plans, would have cured the other nations of a similar wicked obsession, but on the contrary, the virus has spread, and those who before the war were business friends and won the war together, now see their comradeship endangered by newspaper writings that dilate upon ordinary competitive buisness affairs much as an Economic Committee of the Prussian General Staff might have reported to their War Lord.

There are some phases of a nation's internal economy that call for publicity, and the inculcation of a national concern; such as for example, the fuel problem of Canada. This is a question of national defence, because it is essentially a question of national existence. Public discussion of such matters is desirable, and should be frankly undertaken in the open. Our friends in the United States—that is all those whose friendship is worth having—will take no umbrage if Canada undertakes to become thoroly self- supporting wherever it shall prove possible. They will admire us for so doing, and conversely they will secretly despise us if Canada unnecessarily places herself in a medicant attitude. On all such questions open discussion is possible, because the matter is one of public interest.

But apart from pressing matters of our own internal economy, of which coal is the most typical instance, nothing is to be gained, and much may be lost by irresponsible discussion in the newspapers of the supposedly high strategic aims of the political leaders of the United States and the British Empire, aims that do not exist, but which, correctly interpreted, will be found to bear on the real aims of rival oil interests. Apparently these people do not care whether they embroil the United States and Mexico in war, or whether they split the alliance between Britain and the United States that won the war, but looks like losing the peace; causing some people to wonder whether civilization can even yet be saved, and whether it is really worth saving, if all the people of North America have gained from their fighting comradeship has been the absorption of the Prussian viewpoint.

The journalist, or paid propagandist, who endeavours to cause friction between the United States and the British Empire is a most dangerous criminal, and he is especially dangerous in Canada. We suggest that cables from London Sunday newspapers, which appeal to an audience which is not representative of the sentiment of the British Empire, and is certainly not representative of Canadian sentiment, should be read with large allowances; and that, similarly, items appealing to similar audiences in the United States, relating to the malign purposes of the British in securing oil concessions in the Himalayas or round the Great Slave Lake in Canada, for example, should be generously discounted. Also, it would be much better for the oil interests, and for the peace of the world, if these gentlemen would be frank about their commercial aims, and would discontinue their pretence to pose as the champions of national aims, and as the exponents of grandiose schemes that are not one whit better morally, and just as likely of success, as the proposals of Von Bernhardi in "Der Naechste Krieg".

Bolshevism is originally a reflex of the disillusionment of deceived men who have seen their genuine love of country prostituted to base uses by rulers who dreamed and planned wickedness. This is the grain of truth behind the puzzling belief of labor that capital caused the war, and those who play fast and loose with patriotism for purely commercial ends are toying with the same forces which were unloosed in a recent war that is still runnings its course despite official peace treaties.

The Electrical Equipment of the 110 inch Steel-Plate Mill of the Dominion Iron and Steel Co.

A description of the 110-inch ship-plate mill of the Dominion Iron & Steel Company appeared in this periodical in the issue of January last, and in various issues we have referred to the modern character of the electrical drive of this mill.

In "Electrical News" for 15th April, Mr. C. H. Wright, the Nova Scotia representative of the Canadian General Electric Company, give some further details of the electrical equipment, the chief features of which he describes as follows:—

What strikes one in going through the mill is the few men actually at work in handling the ingots and plates, and the extreme smoothness with which the various mechanical and electrical operations are carried out. Electric motors perform practically all the work in the plant from the picking up of the cold ingot to the rolling away of the finished sheared and trimmed plate.

The electrical applications are most complete and the substantial way in which the installation has been made will appeal strongly to the operating man. There will, no doubt, be a minimum of shutdowns for electrical repairs, and the cost of up-keep is going to be exceedingly low.

The wiring is most substantial, being placed in conduits underground and overhead with modern pipe fittings, switchboards, control equipment, etc., mounted away from the rolls, beds, etc. of the plate mill. Master control is used in a great many instances operator being mounted in a pulpit and having a number of master controllers at his hand. From this position he can see easily the operation of the machine he is controlling.

The ingots from which the plates are to be rolled are delivered cold to one end of the plate mill. Their dimensions vary, depending upon size of plate to be rolled. They are 16 in. to 42 in. wide x 12 in. to 18 in. thick, and from 3 ft. to 6 ft. long, weighing from 1½ tons to 8 tons. These ingots are cast and generally poured from the bottom.

The cold ingot is picked up by an electrically-operated crane, and delivered to another crane inside the main building. The electric cranes in the plate mill, of which there are quite a number, are very well equipped. The motors are of standard mill type (MD-250 volts direct current). In the operator's cage the various control equipments are mounted and on the larger cranes magnetic control is used to get proper service on the control equipment. Occasionally magnetic master control is used on the smaller motors to save room and make the operator's duties safer and easier. Plain drum control is used on the smaller motors, but the controllers are over-sized and standardized throughout so that there would be no trouble from burning contact and difficult replacements.

Cranes are wired in accordance with the United

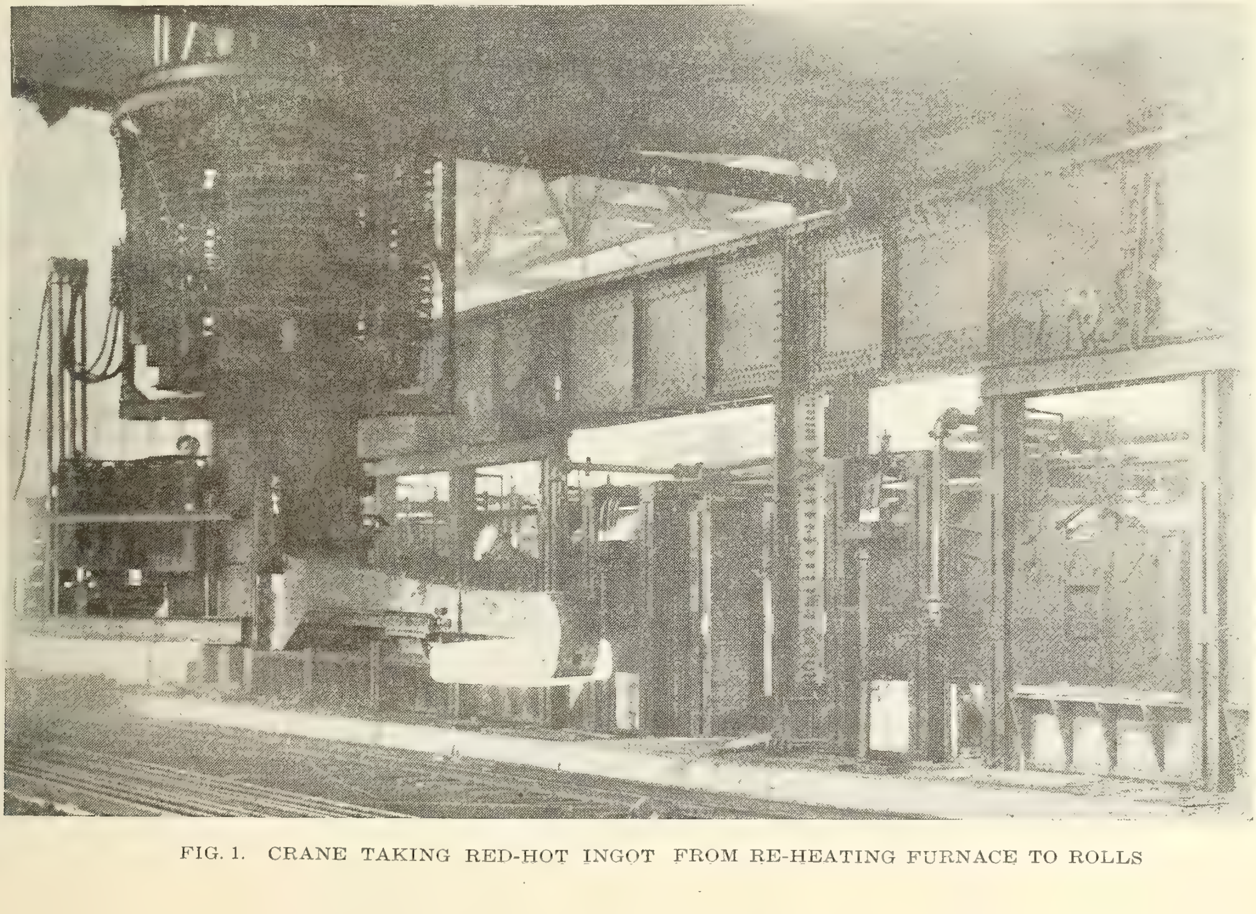


FIG. 1. CRANE TAKING RED-HOT INGOT FROM RE-HEATING FURNACE TO ROLLS

States Steel Corporation's standard specifications. The work is very substantial. The trolleys along crane proper consist of standard 1-in. and ⅜-in. rolled wrought iron. Against these the trolley shoes press, and a much better working arrangement is obtained in this way than from the older style of trolley wires, which gave trouble, due to slackness and lack of stiffness. The current is brought to the cranes proper in standard 30 lb. car rails, which are mounted along the girders supporting the cranes. The result of this style of installation is that a great deal of "ginger bread work" is eliminated, and the electrical wiring becomes as substantial as any other part of the installation.

Once the ingot is landed inside the plate mill, it is picked up by a crane carrying a set of tongs, and carried to the re-heating furnaces. Fig. 1 shows this crane carrying a hot ingot from the furnace. It had previously picked this ingot up from the outside crane and carried it into the furnace. The fronts of these furnaces are shown in Fig. 1 with the doors closed.

Doors are raised by 5 h.p. motor located above and beyond the furnaces which are attached to a steel cable running down trolley shoes. The operator for these doors is located in a pulpit at the extreme north end of the building where ingots come in, and at his hand are the various automatic reversing control equipments, which control the contactors starting and stopping the 5 h.p. motor. This operator also controls the ingot chariot which may be used to carry the ingot along from the north end of the building instead of using the crane shown in Fig. 1 for all such operations.

The crane in Fig. 1 has one motor for opening and closing the tongs, and another equipment for revolving the tongs, and another for running the tongs in and out. The operator, with the contactors, are shown quite plainly in the cut, and above him can be seen the trolleys, which, in this case, are spiral, and are of the standard section 1 in. x ⅜ in. against which the shoes press. Substantial construction is very well illustrated here.

After the ingot attains a proper heat in these reheat furnaces, it is then drawn by the tongs and brought up to the table and to the main rolls, all operations being electrically controlled.

It is not many years since the plate mill operators, while considering that electricity may be used for the cranes and auxiliary operations, yet did not consider it feasible to operate the main rolls by electric motors. The very best mills, however, are now using motor drive on the main rolls.

In the Sydney plate mill the main roll motor is 4,000 h.p. capacity, 82 r.p.m., 6,600 volts, with slip ring rotor and resistance control introduced by means of contactor panels. This 4,000 h.p. motor is shown in Fig. 2. It is probably the largest motor in Canada. The total weight of the motor and fly wheel is about 330 tons. The weight of the flywheel and shaft is about 155,000 lbs. The diameter of the motor bearings is 20 in., outside diameter of the motor frame, 28 ft. 4 in.; the overall length of motor and wheel, 40 in. The flywheel is shown between the motor and the wall. Between the motor and the rolls there is a breakable spindle, which servs as a mechanical safguard against over load on the mill. The motor drives a pair of shafts through gears, these in turn driving the main rolls, which are shown on Fig. 3. The main motor operates continually in one direction. This is not a reversing mill, but the plate is passed through and back between the rolls until the desired thickness is obtained.

One of the motors operating this process is shown in Fig. 3, below the bed. On the main rolls, motor is direct geared, and is, therefore, of low speed, 82 r.p.m. The power-factor of this motor is therefore, somewhat lower than it would be in a higher speed machine, but for mechanical reasons the heavy motor was chosen. So large is this motor that it had to be built on the ground, being shipped in sections, the winding being effected while the motor was in process of erection.

The control panels operating the resistances which are introduced in the secondary of this motor are few in number and equipment looks small compared to that of older installations. The motor comes up to speed very quickly, taking a pre-determined current, and on account of the heavy flywheel effect, it is necessary to have a plugging resistance to stop the motor when the power is shut-off, otherwise it would run for hours, wasting valuable time in the mill.

In contrast to this motor operating the main rolls of the plate mill there has been installed in the rail mill, but not yet operating, a 3,000 h.p. motor, 360 r.p.m., which operates through cut helical gears to the main rolls of the rail mill. The higher speed of this motor gives a better power-factor and the dimensions of the motor are much smaller. What strikes one im-

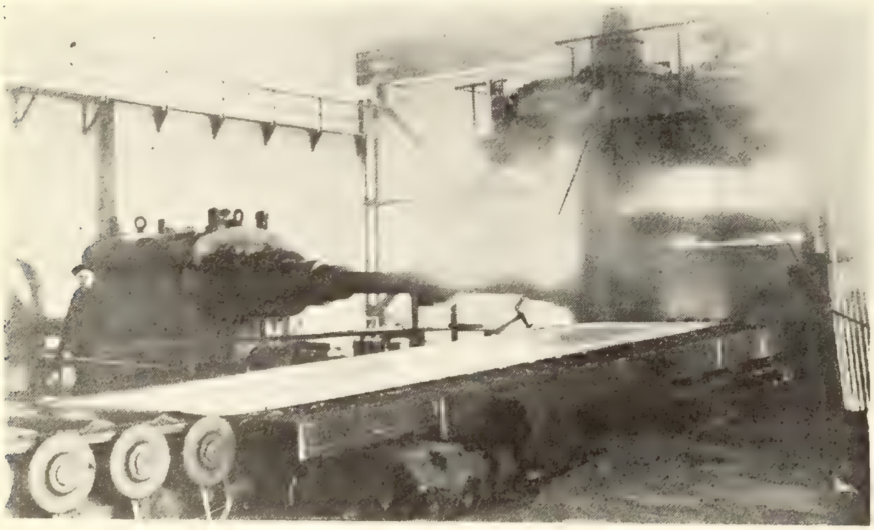


FIG. 3. THE PLATE ROLLS.
Shows flexible coupling to Motor Room, and plate in process of rolling.

mediately is the diameter of the shaft of this motor which is only 5 in. The question of power-factor was important in the choice of geared or direct connected motor. Naturally, the cost of entire installation is increased considerably by the introduction of the expensive cut gear. This rail mill motor is not yet in operation.

Returning to the main rolls of the mill motor, possibly one of the most interesting applications is that of motors to the middle roll. These two motors (MDS-109) are used to elevate the middle roll until it strikes the top roll. When the middle roll strikes the top roll, the motors and gearing must immediately come to rest, but the motors must continue to exert a torque to press the middle roll against the top roll with a great weight. The speed of travel of the middle roll is approximately 6 in. per second. When the operator in the pulpit moves the master switch to the lower position, the motor torque holding the middle roll against the top roll is removed, and the middle roll lowers. When it strikes the bottom roll, it must bear

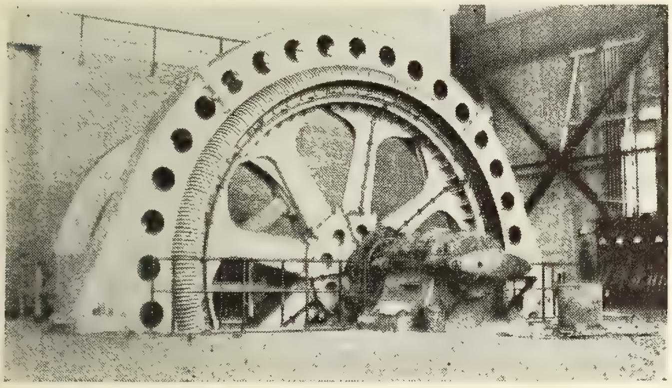


FIG. 2. MAIN ROLL MOTOR
4,000 h.p. 82 r.p.m., 6,600 v.

down upon it with a considerable pressure, differing from that in the case of the pressure against the upper roll. The falling distance varies from 1/4 in. to 20 in., and the speed of the roll is limited by dynamic braking. The motor is controlled with contractors and master switches, all of which are located at some distance from the main rolls. A number of the control panels are erected side by side at this point with their resistances, etc., immediately behind them, all in a most substantial manner, and standing near the rolls, one hears the constant hammer of the contactors. Controlling machines perform various functions, such as raising and lowering of the table, raising and lowering the middle roll, bringing back and forward the hot plate until it is rolled to the proper thickness and passes on to the next operation.

The service which these control panels give shows the perfection of such control equipment. They function with the minimum of trouble, and this equipment is mechanically as substantial as anything else in the whole mill.

The pulpils are at some distance from certain of the contact panels, but by locating these all together, proper wiring and inspection is facilitated, and a choice can be made to suit good conditions.

After the plates leave the main rolls they have to be levelled and trued. This operation is electrically controlled and plates having been levelled, are carried across a series of conveyors to a point where they may be inspected by turning off. The motors for these operations are located below the floor in concrete beds, their control panels being located some distance away, the operator being in a pulpit considerably above the ground. As an instance of how these motors are applied the following large mill type M.D. motors are used:—

Front and back tilting tables 60 h.p.; lifting rig for tilting table 2-150 h.p. M.D. L09 motors; 110 in. plate mill screwdown 2-100 h.p.; plate leveller 1-40 h.p. M. D. 108; cooling bed tables 4-40 h.p. M. D. L05 motors; cooling bed chain drive 2-40 h.p., M. D. 105 motors; inspection turn-up chain conveyor and rotary shears, each take 40 h.p. motors.

After leaving the inspection tables the plate goes on, and is marked proper size, passing between rotary shears, which true the edges. It then goes on to larger shears which trim the ends, one of which, for instance is an 144-in. shear, operated by 200 h.p motor, of very large dimensions. It is interesting to watch these plates being held on the bed of the shear by the magnets inserted in the bed. Scrap is carried away from the shears by means of motor-operated conveyors, while the plate proper is carried across on a castor bed, which looks like a large number of table legs inverted with their castors in the air. The plate is moved by hand across to scales or other points preparatory to shipment.

The smoothness of operation of this mill makes it a delight to watch, and naturally the demand for power is, at times, enormous. For instance, tht 4,000 h.p. main roll motor, if it is starting or rolling at the same time as other large operations are going on the demand on the power house assumes large peaks. The new power house in process of construction is designed for a capacity of 20,000 kw. It is not yet completed, but there will shortly be in operation in that power house something like 12,000 kw. of steam turbo-generators which will deliver current at 2,200 volts, 60 cycles, or at 6,600 volts, 60 cycles in the case of the larger units. The 6,600 volt current is only handled through motor operated switches, while the 2,200 volt current is controlled by solenoid operated switches, the latter on a pipe frame work with a 6,600 volt equipment mounted in cells using standard construction of this kind. Conductors from the turbine to the main switchboard consist of bus-bar section carried on standard bus-bar supports in brackets and up along the wall to an outgoing steel tower, suitably designed.

Practically all the drives in the plate mill excepting that of the main rolls, are by direct current motors. This direct current is obtained through a 1,400 kv.a. synchronous motor driven generator set, located in the same building as the 4,000 h.p. main roll motor. These synchronous motor condensing sets for other parts of the plant are suitably located, taking current at 2,300 volts or 6,600 volts, 3 phase, and delivering 275 volts direct current.

The consulting engineer for the plate mill and No. 3 power house, above described, was Mr. B. R. Shover, of Pittsburg. The electrical engineer of the Dominion Iron & Steel Co., Sydney, is C. Boucher. The superintendent of the plate mill is Mr. W. G. Wilson. The contractors for the electrical equipment in the plate mill and power house throughout were the Canadian General Electric Co., Ltd.

The Dominion Iron and Steel Company's New Ship-Plate Rolling Mill

A paper presented at the Toronto Meeting of the Canadian Mining Institute, March, 1920 and at the Glace Bay Meeting of the Mining Society of Nova Scotia, May, 1920.

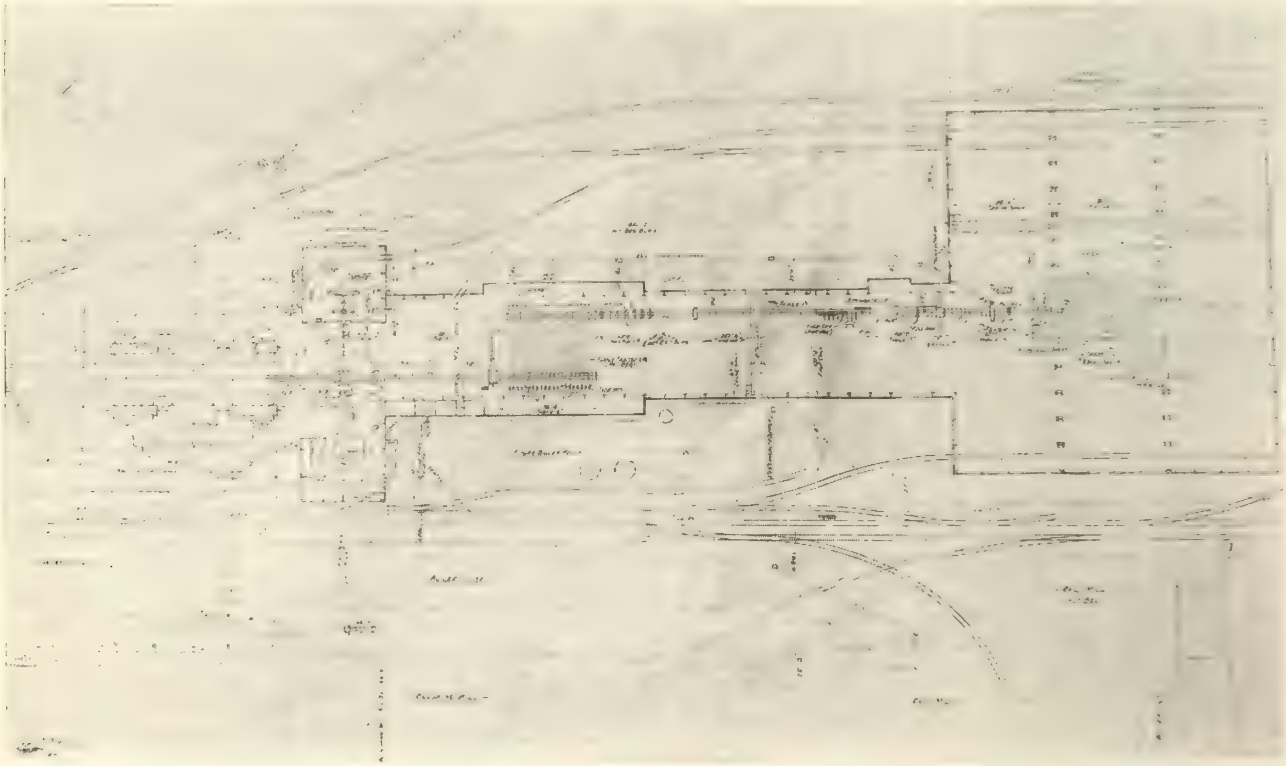
By H. E. RICE.

This very latest type of mill, erected at a cost of $5,000,000, and which, at the press of a button by the Hon. Alex. Johnson, Deputy Minister of Marine and Fisheries, was officially put into operation February 19, 1920, is the result of the negotiations opened during 1918 between the Canadian Government and the Dominion Iron and Steel Company.

The original contract terms and their later modifications are no doubt familiar to all interested persons and need not be discussed. The undertaking is one of national importance and upon its success depends to a considerable extent the advancement and extension of the Canadian shipbuilding industry.

Foundations.—Construction of the foundations included the placing of 18,500 cu. yds. of concrete, both plain and reinforced, for buildings and machinery foundations. The concrete for the heavy machinery foundations for the furnaces, motor and mill machinery was distributed from a 90-foot tower with steel chutes, this particular plant being designed and erected on the site for the prosecution of this work. On numerous occasions, with this tower, over 400 yards was placed per day of 10 hours, using a ¾-yard mixer.

It might be noted that the placing of concrete was carried on continuously during the winter months. This was accomplished by pre-heating the materials



GENERAL LAYOUT OF MILL AND STOCK ROOMS.
By Courtesy of C. M. I. Bulletin, May, 1920.

and covering freshly placed concrete with tarpaulins, using steam and open fires where necessary. It was clearly demonstrated that if concrete was placed while warm and protected for about 12 hours, no further trouble need be expected from frost.

Site.—Immediately the negotiations were concluded the clearing of the site was undertaken. This involved the removal and re-location of seven large structures and numerous small buildings, the re-location of the then existing railway tracks and the transferring of immense quantities of miscellaneous stores material.

The grading to yard level necessitated the removal of 200,000 cubic yards of rock and earth, and the earlier part of this work was carried out under winter conditions which made it especially difficult.

Sewers.—It was necessary to excavate and build an extensive sewer system. This consisted of a reinforced concrete sewer—3 by 2 feet, about 1,200 feet long—draining the furnace and mill foundation sumps; also tapping all other machinery pits with 12-inch pipe. The sewer excavation was about 22 feet deep. The concrete sewer walls were 8 inches thick.

Wherever possible, the excavation was dug neat, to avoid the use of outside forms. Collapsible forms were

---

*General Superintendent Dominion Iron & Steel Co., Sydney.

used for the centre and these were made in such a way that they could be readily removed and re-used as the work proceeded.

Buildings.—These cover a total area of 240,000 square feet, or 5½ acres, and are of the most modern mill type construction, consisting of concrete foundations, structural steel frames, brick walls, with slow burning roof construction, built from 2⅜-inch T. & G. plank as finished on the site, and covered with Barret specification tar and gravel roofing.

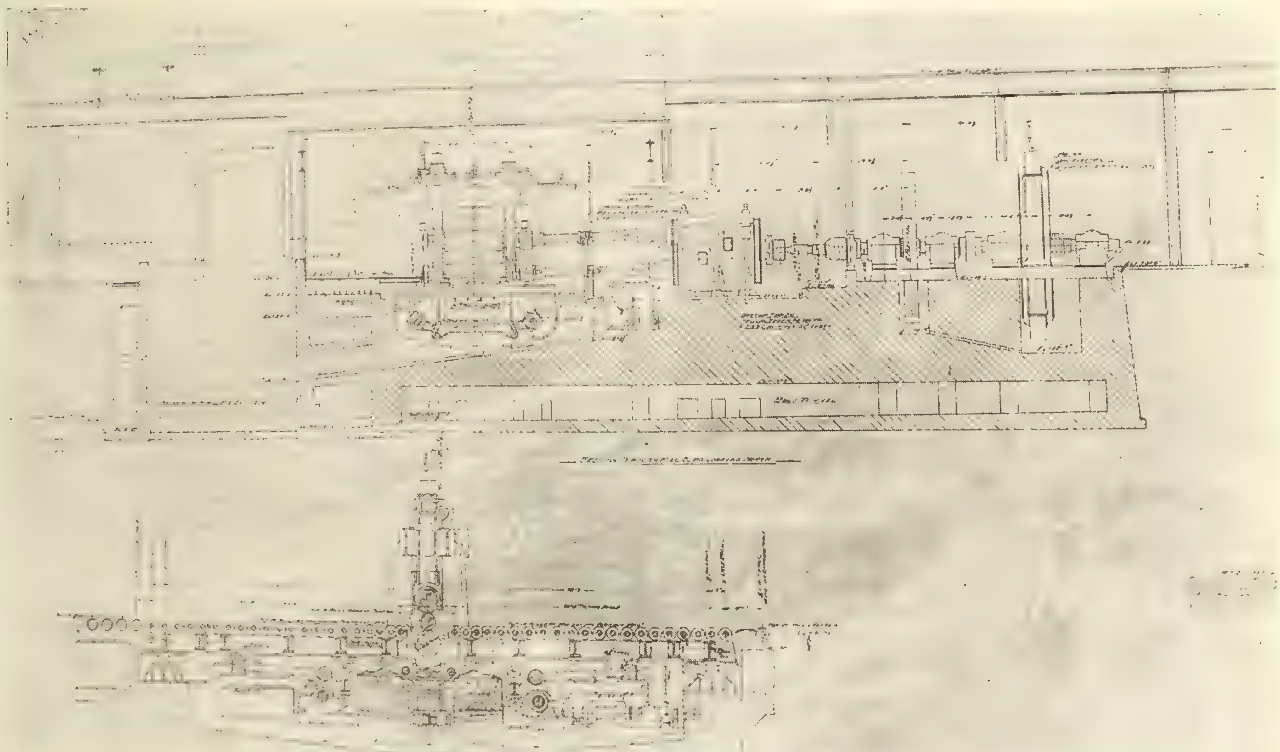
The steel frame-work involved the erection of 3,500 tons of structural steel, which was supplied and erected by the Dominion Bridge Company.

The construction of these buildings was designed and carried out in the most simple and substantial way. Reinforced concrete sills and lintels were moulded on the site and lifted into place by a locomotive crane, thus avoiding slow and expensive arch work over doors and windows. The erection of the buildings entailed the laying of over 3,000,000 bricks in the walls, the placing of 60,000 square feet of windows and of 5,000 square feet of doors.

ingots may be stored in the slab yard and later taken on cars to the heating furances.

The heating furnace building is 140 by 227 feet, and contains six gas-fired regenerative side door heating furnaces 11 feet 7½ inches wide by 51 feet long, inside the buckstays; the width of furnaces, inside brickwork, is 9 feet and the length of furnace hearth is 34 feet. Gas and air regenerative chambers of ample proportions are provided underneath each of these furnaces and each one is supplied with a self-supporting steel draught stack 5 feet inside diameter of brickwork and 130 feet high, above the furnace hearth level. Hand-operated reversing valves are used on the stack flue.

Debenzolized oven gas with a thermal value of 560 B.T.U. is used for fuel. This gas is brought through a 24-inchmain from the coke oven plant (situated half a mile distant) and, as it is not preheated, both air and gas regenerators are used for preheating air. However, the arrangement of valves, flues and ports is such that both gas and air may be regenerated in case coke oven gas should be temporarily unavailable,



PLAN AND SECTIONAL ELEVATION OF PLATE MILL.
By Courtesy of C. M. I. Bulletin, May, 1920.

Although all buildings are practically fireproof and represent a most permanent construction, as well as embracing very desirable architectural features, the unit cost per square foot was remarkably low, being in the shear building only $5.00 per foot, with a maximum of $10.00 in the furnace and mill buildings.

Building and Mill Equipment.—A slab yard and ingot storage 80 by 200 feet is provided adjacent to the north end of the mill buildings, and is served by a Morgan Engineering Company's 10-ton 3-motor E.O.T. crane. Narrow gauge tracks for the open hearth department pass under this crane and extend into the furnace building, so that hot ingots may be taken direct from the open hearth to the furnaces, or the

and it should become necessary to use producer gas for fuel. Each furnace has four brick-lined cast iron doors 8 feet 6 inches from centre to centre, the width between door jambs being 6 feet, and the clear height from foreplate to skewback 4 feet. The furnace doors are individually operated by General Electric Co.'s motors acting through a worm-geared crank motion. The water-cooled door jambs and skewbacks are of welded steel—Blaw-Knox patent.

For average operation is is estimated that the coke oven gas consumption will be 9,000 cubic feet per ton of ingots heated, while the water consumption per furnace for jambs and skewbacks will be about 120,000 imperial gallons per 24 hours. Venturi meters of the

recording-indicating and integrating type are used for measuring both gas and water on these heating furnaces.

It may not be amiss here to refer briefly to the method used for erecting the heating furnace stacks, which, as previously stated, are 135 feet high and 5 feet inside diameter, with heavy self-supporting bases.

It was decided that the quickest and cheapest way to erect these stacks was to assemble, rivet and paint them on the ground, and then hoist them into place in one piece. In order to do this, an A-frame was hastily built from stock lumber. When completed, the hoisting frame, or set of shear legs, was 85 feet high. The stacks weighed about 24 tons each . (See Fig. 3.)

The tackle used was a ¾-inch steel cable, roved through two 3-sheave steel blocks, using a standard gauge locomotive for the main lift and a locomotive crane to take the weight of the base until the main hoist had lifted the stack to a vertical position. The stacks were reinforced with wood bracing, inside and out, at the point where the sling was attached, which was about 65 feet from the base, or approximately 10 feet above the centre of gravity.

The workmen were much pleased with this method of construction and showed their enthusiasm by reducing the time of erection in each case, until the completion of the last stack, which was lifted and bolted in place in the remarkably short period of 22 minutes.

Two Morgan Engineering Company's' 10-ton, 5-motor revolving slab chargers, having a span of 55 feet, are arranged to serve the six heating furnaces in conjunction with an electrically operated ingot chariot arranged on the centre line between furnaces. This ingot chariot and all 24 furnaces door hoists are remotely controlled from a pulpit at the north end of furnace building. It will be noted that all heating furnaces are arranged in plain view of the mill operator—a very desirable feature from the standpoint of operating efficiency.

The mill building proper is 80 feet 10 inches by 250 feet in plan, and houses the mill motor and mill, together with its tilting tables and auxiliaries, operating pulpit, roll shop, roll rack, salt bin and scale pit. The entire building is commanded by a Morgan Engineering Company's 6-motor E.O.T. crane equipped with 50-ton main hoist and a 10-ton auxiliary hoist. A brick wall separates the motor room from the mill proper. This wall extends from floor level nearly to the crane girders, a fireproofed canvas curtain being arranged to close the opening between the top of this wall and the roof, so that by raising this curtain the 50-ton crane may serve the motor room. It will be noted that standard gauge railway tracks are arranged under either end of the 50-ton crane runway.

Mill.—This is known as a 110 by 36-inch three-high plate mill and is of the Lauth type. It consists of one stand of rolls served by tilting tables and is driven by a 4,000 H.P. 82 R.P.M. motor through a set of cut herring-bone pinions. The middle pinion is driven by the motor while the upper and lower pinions are connected to the upper and lower mill rolls respectively, through leading spindles and coupling boxes. The pinion gear reduction is about 10 to 6, so that the mill is driven at about 49 R.P.M. The top and bottom rolls are 36 inches in diameter and the middle roll is 24 inches in diameter; the length of all rolls is 110 inches between necks, and the horioзntal distance between mill housings is about 113 ins., thus the widest sheared plate that it is commercially practical to produce is about 98 ins. The mill screw drive is located on top of housings and consists of two 100 H.P. motors connected to a common shaft and driving screws through a worm wheel reduction. These motors are electrically connected for series-parallel operation. The front and back tilting tables are each about 30 feet in length and each supports 21 live rolls. Two 60 .P. motors drive the live rolls on each tilting table. The power for raising and lowering the tilting tables is supplied by two 150 H.P. motors acting through a gear reduction and a crank motion. The tables are balanced by a closed hydro-pneumatic system acting on the crank motion through hydraulic cylinders and a hydraulic accumulator. The top is hydraulically balanced while the middle roll is mechanically balanced and electrically raised and lowered by means of two 150 H.P. motors.

Main Drive.—The mill motor is the General Electric Company's Type 1—88 pole, 4,000 H.P., 82 R.P.M., induction, 3-phase, 60 cycle,—form M., 6,600 volts. The flywheel is direct connected, mounted between its own bearings, and weighs approximately 155,000 lb. This flywheel has a diameter of 22 feet 7 inches while the rotor has a diameter of 21 feet 4 inches. The $W.R.^2$ of rotating parts is approximately 20,000,000 lbs. The total weight of motor and flywheel is about 659,000 lb. The maximum running torque in lbs. at 1-foot radius is 700,000.

The 1,000-Kilowatt motor generator set is provided for furnishing direct current at 250 volts for all other motors used for the mill and its auxiliaries. The General Electric Co. have supplied the entire electrical equipment.

The most important item, perhaps, in the building of this mill was the construction of this huge motor, which may be briefly described as follows:—

On account of the enormous weight involved, it was necessary to assemble the stator frame, rotor, spider, press in the shaft, build the laminated cores, and to wind both stator and rotor, after the motor was placed in position on the base. The stator and rotor cores each contain over 60,000 laminated sheets of 14 mills thickness; these sheets were placed in position one at a time and were so placed as to break joints, thus making, as nearly as possible, a solid core. The cores are 26 inches in width, thus making it necessary to press several times during construction in order to place the proper amount of sheets in each core. This work was accomplished by means of a special pressing outfit.

The stator winding is what is known as open slot construction. Each coil is a complete unit in itself and, in the event of any coil being injured, it can readily be removed and another substituted. These coils are held in position by fibre wedges, driven into grooves in the top of the coil slots. In addition to this, the projecting ends of the coils are tied down to a heavy supporting ring, thus doing away with the chance of coil vibration. These coils were tested from time to time as they were placed in position, to make certain that they were in perfect condition. The testing was made with double voltage, that is 12,200 volts. After the soils were all placed in position, and before the three phases were connected together, a double voltage test was made between the phases.

The rotor winding is that is known as the semi-open slot construction; the winding being held in position by wedges tightly driven under the projecting parts of the slot teeth; the projecting ends of the windings are clamped down to supporting flanges. This is ac-

complished by means of sectional bands. In the event of a damaged coil, these bands can readily be removed and a new coil substituted. These coils were also tested at double voltage.

The pressing in of the rotor shaft was accomplished by means of a hydraulic jack; the pressure required was 370 tons. The shaft is 20 inches in diameter, and has a bearing surface 50 inches in length.

The control equipment for this motor consists of a master controller and six automatic current limit accelerating points and one plugging point, both forward and reverse, six of which may be hand-controlled from the master controller. In case of failure of voltage while running, the master controller must be returned to the off position before the equipment can again be started. Sufficient resistance is connected in the slip ring circuit, to give approximately 15 per cent slip at full load.

The flywheel consists of two sections of hub and spider and four sections of rim. The total weight of the flywheel rim is 120,000 lb., and the total weight of the motor and flywheel is 659,000 lb. The peak loads of the motor are absorbed by the 120,000 lb. flywheel rim.

The motor is built to withstand an overload of 125 per cent for two hours and a momentary overload of 250 per cent. The installation of the motor and its auxiliary equipment was carried out under the supervision of the General Electric Company's engineering construction staff.

During the test, when this motor was first started, after shutting off the current, the motor drifted for an hour and forty-five minutes, which was good evidence of the splendid balance and alignment which had been attained by the erecting engineers.

The hot-bed building, about 100 feet wide and 560 feet long, is equipped with a crane runway over its entire length for a Morgan Engineering Company's 10-ton, 3-motor, E.O.T. crane. A standard gauge railway track is arranged to enter this building underneath the crane runway. Plate mill machinery housed by this building consists of the runout tables, plate leveller, hot bed chain conveyor, inspection turn-up, layout chain conveyor, and rotary shears and tables.

The shear building is 300 feet by 250 feet in plan and is equipped for its entire length with three 96 ft. 6 in. crane runways, each supporting a Morgan Engineering Company's 10-ton, 5-motor, double trolley, E.O.T. crane. This building houses the 108 by 14-inch cross-cut shears, 156 by 14-inch trimming shears, 114 by 24-inch trimming shears, 5 scrap shears and 2 10-ton dial scales. The castor bed is arranged for the easy handling of plates from all shears to the scales. They are also excellent track facilities for shipping, as well as extensive plate storage space, which is so necessary for the economical operation of plate mills.

All machinery for the plate mill, except the 144-inch shear, was furnished by the United Engineering & Foundry Company, of Pittsburgh, Pa. The 144 by 24-inch shear was furnished by the Morgan Engineering Company, of Alliance, Ohio. All cranes and mill machinery are motor-driven with General Electric Company's 230 volt equipment. Auxiliary apparatus, such as shear plate grinder, test piece milling machine, air compressor, hydraulic pump, etc., are also motor driven.

The supply of fresh water required for this mill amounts to about 1,500,000 imperial gallons per 24 hours. The cooling water for the heating furnaces is returned to a cooling pond and re-circulated, while the cooling water for the mill, which is contaminated with mill scale, grease and salt, is run into the sewer.

Power for the operation of the plate mill is supplied by a G. E. 5,000-K.W. turbo generating unit in the company's new No. 3 power house (erected at a cost of $1,000,000) and is transmitted about a mile at 6,600 volts.

Extensions to the open hearth building were necessary, in order to provide room for bottom casting the slab ingots as required for plate mill consumption. This auxiliary feature of the main installation involved the expenditure of approximately $600,000 and, without considering the necessary extension to the electrical power plant facilities, brings the total cost of the plate mill to $5,000,000.

The work was entirely supervised by the Steel Company's engineering and construction departments, and the erection of all buildings and machinery, with the exception of the structural steel and the main motor, was carried out by the company's engineering and construction forces. It is a remarkable fact that, of nearly 4,000 bolts in the machinery and building foundations, not one had to be changed; this testifies to the accuracy with which the drawings were prepared and the work executed. The entire project represents the latest practice in the manufacture of steel plates, and aside from the fact that it is a most creditable extension to the steel plant of the Dominion Iron and Steel Company, Limited, it cannot but be a most valuable addition to the manufacturing wealth of Canada.

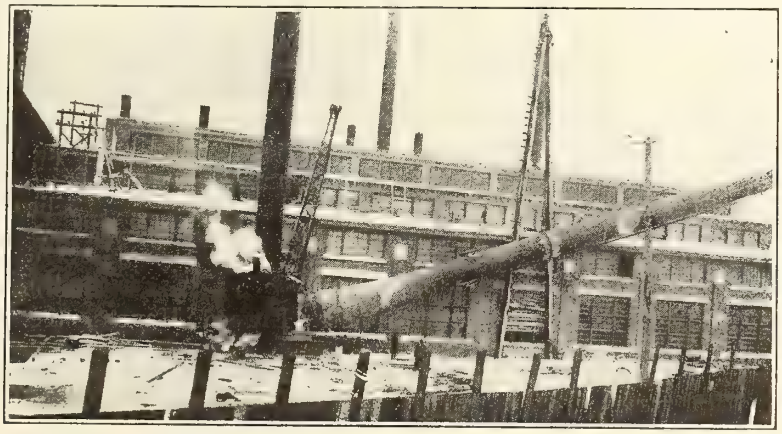


FIG. 3.

Meeting of the American Electro-Chemical Society, Boston, Mass., April 8-10, 1920

Symposium on Electrically Produced Alloys.

The 37th annual Meeting of the American Electrochemical Society devoted much attention to the use of electric furnaces both in ferrous and non-ferrous metallurgy.

The sessions of Friday and Saturday the 9th and 10th April were held jointly with the American Institute of Electrical Engineers, and were very largely devoted to consideration of the use of the electric furnace in the production of ferro-alloys, and the problems of electrical supply for the growing and exacting requiremtnts of increasing numbers of electric furnaces.

Fundamental Problems of Alloy Research.

On Friday morning, with President W. D. Bancroft of the Electrochemical Society in the chair, Mr. H. E. Howe's paper with the foregoing title was summarised by the Secretary. Mr. Howe represented the work of the Alloys Research Association of the National Research Council of the United States, and pointed out the large number of fundamental investigations which should be undertaken to enlarge our knowledge of metallic alloys. The Alloys Research Association would at first supply needed information, where it already exists, and later would endeavour to incite laboratories to undertake the determination of the long list of unknown but necessary data which the paper outlines.

Mr. R. J. Anderson read a paper on "Recent Developments in the Ferro-Alloy Industry," which was published in abstracted form in our April issue.

Mr. C. B. Gibson dealt with the "Manufacture of Ferro-Alloys in the Electric Furnace" from the standpoint of the practical operator. Among other matters he stated that of the more recent developments in electric furnace equipment, "undoubtedly the greatest improvements have been in those devices for automatically controlling the current input to furnaces by a movement of the electrodes."

Canadian Competition in Ferro Alloys.

In the discussion that followed this group of papers, one speaker remarked that there appeared to be some fear of outside competition with makers of ferro-alloys in the United States, and enquired what country was to be regarded as a dangerous competitor. It certainly was not Europe, which would have sufficient to do to supply its own needs. This speaker thought Canadian competition was most effective, and mentioned that ferro-silicon was being produced in Canada at a figure which United States manufacturers could not excel.

Oxygen Enrichment of Blast-Furnace Air.

Dr. Richards suggested that the blast-furnace with oxygen enrichment of the blast was now a possibility because of the improved methods of making oxygen in large quantities, in which case the blast-furnace would be a competitor of the electric furnace in alloy manufacture, as it would be possible to deal with high silicon metal in the blast-furnace. Mr. Cottrell was very enthusiastic, said Dr. Richards, about the possibility of supplying oxygen of a richness extending to the use of pure oxygen. With enriched air it might be possible to deal in the blast-furnace with up to 30 per cent or possibly 50 per cent silicon.

Peruvian Vanadium.

Dr. Saklatwalla read a paper on the "Development of Ferro-Vanadian Metallurgy,"

Dr. Saklatwalla said vanadium in metallic form was scarce, and the known available supply did not supply one-tenth of the demand. The only deposit known was in the Peruvian Andes. (For description of this deposit see chapter on the Minasragra Vanadium Mine, page 487, of Miller and Singewald's "Mineral Deposits of South America.") Dr. Saklatwalla was subjected to a fire of questions, ranging from the available supply of vanadium to the effect of influenza on Peruvian llamas.

Asked whether in consideration of the altitude of the Peruvian deposit, the physical and transportation difficulties, he thought sufficient vanadium could be furnished to supply the demands of the alloy industry, he said the deposit was found at 17,000 feet above sea-level, and was the highest point at which human industry was carried on, and that llamas were becoming exterminated in all South American countries. A concentration plant was proposed at the mine site to lessen bulk of transport, and a railroad was also being built. With these increased facilities he thought the future of the vanadium supply was very bright. The construction of the improvements might take two years.

Dr. Richards thought from a consideration of the history of other metals of rare occurrence, particularly the case of tungsten, that it might be expected that other deposits of vanadium would be found.

Mr. Norris, of the Vanadium Steel Corporation, said he would like to allay any fears as to the future supply of vanadium. By August a railroad should be in operation at the mine, and by that time, judging from the present demand, his company expected to be able to fill all orders. As to increased price, Mr. Norris said his company had not increased the price unduly, and not anything like the increase in the price of tungsten. During the war the old American Vanadium Corporation maintained a low price on vanadium, but when the war closed the price was advanced, but not proportionately as much as the prices of other materials. The present price was $6.25 per lb., and the speaker defied anyone to quote a material used in the steel industry that had not advanced in greater proportion. The silicon content of vanadium had been higher, but this was a result of putting out the metal as rapidly as possible. The mining methods pursued at the mine had been those common to South America and comparatively crude. A slide had covered the best workings, and it had taken a year to clear away. Silicon was not objectionable, except in one instance, namely in the crucible process. In the electric furnace it was entirely possible to maintain a low percentage of silicon in the steel, but in the crucible process it was not possible to slag off the silicon.

Stellite.

Mr. Elwood Haynes, the inventor of the cobalt-chromium-tungsten alloy known as "Stellite," read a paper describing his initial experiments, which is republished in this issue. Mr. Haynes' product is very interesting to Canadians, as it was the discovery of large quantities of cobalt ore in Northern Ontario that

made the necessary quantity of cobalt oxide available at moderate prices.

Professor Richards mentioned that the electric furnace was being used in England for the melting of armor-plate scrap in order to save the chromium content.

Papers on "Nickel-chromium and Other Alloys," by R. M. Major; on "Ferro-Manganese" by E. S. Bardwell, and on "The Manufacture of High-Speed Steel in the Electric Furnace" by Ray C. McKenna, were presented as a group.

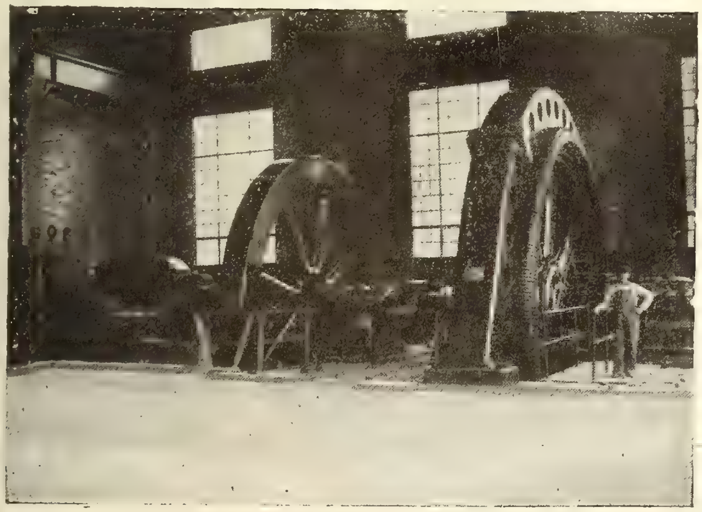
In regard to nickel-chromium alloys, Mr. Major said these could not be hardened by any heat treatment, but could be hardened by cold working. In answer to a question as to whether tests had been made of the wear of nickel-chromium steel upon the same material at temperatures of 800 degrees C., it was stated that no tests had been conducted under these conditions, but it was hoped shortly to make them.

Mr. McKenna emphasised the necessity for purity of the base metals used in the electric furnace as being equally as great as in the crucible process.

Mr. Alcan Hirsch described the production of ferro-cerium and samples of the alloy were shown, together with specimens of the lighters for oxy-acetylene uses, and as a substitute for matches. A special flaming variety is made for use in miners safety lamps with internal ignition. Some possibilitiy was suggested of the use of ferro-cerium as a deoxidiser and scavenger in steels, but so far no really serious uses of this nature have been attempted.

Papers were presented by T. D. Yensen, Research Metallurgist of the Westinghouse Company on the "Magnetic and Electric Properties of Iron-Nickel Alloys," and by M. A. Hunter and J. W. Bacon on "Some Electrical Properties of Titanium Alloys."

The session was adjourned for lunch, and in the afternoon the members, by the courtesy of the General Electric Company, were shown over the Lynn Works, transportation being furnished by the General Electric Company.



A TYPICAL GENERAL ELECTRIC UNIT.
A 4,000 h.p., 82 r.p.m., 6,600 v. Motor driving 110″ Plate Mill at Fairfield Works of Tennessee Coal, Iron & Ry. Co. A duplicate of the motor supplied to the Dominion Steel Co. at Sydney.

The Lynn Plant Visit.

This visit was one of the most enjoyable features of the meeting. Particularly impressive was the attention paid at Lynn to the welfare and comfort of the workpeople. The provision of dance floors and pianos at numerous points within the factory buildings enables an enjoyable break in the work-hours following the noon and midnight lunch-hours. If the appearance of the employees particularly the female employees, is any guide, the General Electric Company is being well repaid for its recreational and social work by the health and happiness of its employees, who normally, at the Lynn plant, number from 12,000 to 14,000 persons.

Visitors were also given an opportunity to look over the schools and training rooms where apprentices are trained, the General Electric Company's arrangements being those of a vocational school of the best type, which not only teaches young men but pays them wages while training.

The time at the disposal of the members was not sufficient to allow them to make as leisurely an inspection of the huge plant as is necessary for its full comprehension, but every thanks is due to the General Electric Company for the courtesy of the guides, and the general excellence of the arrangements made for the visit.

Evening Session, Friday 9th.

Following an informal dinner of the American Institute of Electrical Engineers, in which the members of the Electro-chemical Society took part, an evening session was held, the chief feature of which was a symposium on power for electro-chemical purposes.

"Ironing Day" in Ontario.

Mr. John L. Harper spoke on the availablity of power for electro-chemical purposes. He stated that at Niagara Falls approximately 500,000 kilowatts was developed out of a total of possibly 5,000,000 kw., but only a portion of this could be adapted to industrial uses of continuous character. Dr. Fitzgerald said he was credibly informed that the Hydro-Electric plants in Ontario noticed a distinct peak on Tuesdays owing to it being "ironing day." He suggested that power should not be frittered away, but that in its use due regard should be had to the necessity of reserving power for electro-chemical industries of a continuous character and of national importance.

Mr. E. A. Wilcox dealt with the electric furnace from the standpoint of the Central Station. He suggested consideration of the greater use of off-peak power in foundries, if it should be possible to get men to work at night. He also referred to the advantages of the use of off-peak power at night in electric furnaces for casting ingots to be used in rolling mills.

Mr. H. L. Hess, of the Hess Steel Corporation of Baltimore read a paper on "The Electric Furnace and the Central Station." He recalled the great indignation among the population of one small town where furnaces of an earlier type were operated when the wildly fluctuating load shut down the moving-picture houses. Many unfortunate experiences in the past were caused by heavy fluctuations in current use. Some installations were made on small power companies lines, with disastrous effects. The new designs of 3-phase arc furnaces and proper regulating control equipment had much improved matters.

Mr. Hess said that for the production of steel of high grade the use of raw materials of the purest

character was desirable, and that practice which most nearly resembles crucible practice and crucible conditions will in the electric furnace give the best results, and neglect to observe this rule had led to some disappointing results and a bad name for the electric furnace unnecessarily.

Electric Furnace Has Come to Stay.

The speaker said he believed the electric furnace for steel-making had come to stay, and that it will become more and more necessary for the central station to figure upon the characteristics of operation peculiar to this type of furnace, and decide as to the desirability of the load.

Mr. Wallace G. Berlin read a paper dealing with the power problem from the standpoints of the furnace operator. He advocated the use of furnaces of comparatively small capacity operated at high speed.

Mr. Augustus C. Smith dealt with the problems presented to the electric companies supplying current for electric furnaces from a central station, and showed how much could be done to avoid surges on the line by careful handling during the melting-down period. Unless furnace men can be trained to handle the furnaces carefully during this operation, electric power companies must limit the number of furnaces on their supply systems because of the abnormal momentary peak loads. Co-operation by the furnace operator with the power companies was asked.

A paper by J. W. Beckman, which is published in this issue, deals with the developments of hydro-electric power in Scandinavia, and draw analogies and lessons for the United States which are probably still more applicable to Canada, a country that in many respects resembles Scandinavia, but more particularly in the possession of water-powers, and iron ores of high iron content situated in places where coal and coke are dear or unobtainable, and wood is equally scarce.

Saturday Meeting. Harvard University.

The morning session of Saturday was held in the New Lecture Hall at Harvard University, with Dr. Bancroft in the chair.

The Soderberg Self-Baking Continuous Electrode.

Dr. Richards, the Secretary, summarized a paper by himself describing the Soderberg Self-Baking Continuous Electrode, which he had seen in operation in Norway. This electrode was 34 inches in diameter. The principle embodied the idea of feeding continuously unbaked electrode mixture to the furnace, the mass being baked by the heat of the furnace, the operation being practically continuous during the life of the furnace. The electrode used up slowly. Once a week a new casing was needed at the cold end, and the electrode only needed to be lifted two or three times a week. About half the cost of the ordinary form of electrode was claimed to be saved. A number of European firms were adopting the method. At Anniston, Alabama, the self-baking continuous electrode was being introduced in three furnaces of the Southern Manganese Carbon Company, and were expected to be in operation next month. The company was willing to allow anyone interested to see the electrodes in operation. Dr. Richards said that no smoke or fumes were emitted from the baking electrode.

The paper by C. A. Keller, of Livet, France, describing the manufacture of synthetic cast iron — which was published in the March issue of "Iron and Steel"—was taken as read. It was suggested that written discussion of this paper should be asked from Mr. Turnbull, of Hamilton, Ont., who had done a great deal of melting scrap in the electric furnace during the war.

Brass Melting Furnaces.

The discussion on various types of brass-melting furnaces, which was taken part in by representatives of a number of well-known electric furnaces, was very animated, and followed a paper by H. M. St. John on the "Evolution of the Electric Brass Furnace." The concensus was that there was no "best" brass furnace. There were furnaces on the market adapted to each set of conditions met with in brass and bronze manufacture, but no general "cure-all."

A general review of the position of the electric furnace in iron and steel metallurgy was given by Lewis B. Lindemuth, which, after making careful comparison between the four accepted methods of steel-making namely, the Bessemer, open-hearth, crucible and electric processes, suggested that when properly installed and operated, the electric furnace is metallurgically the best steel-making apparatus, and economically cheapest.

Dr. Richards suggested further that the treatment of already melted steel (instead of cold melts) was the great future work of the electric furnace. He believed that the time had come when the electric furnace would be a part of the ordinary equipment of every steel works.

Electric Arc Melting Furnace and the Central Station Electric Company.

"The Electric Arc Melting Furnace and the Central Station Electric Company" was the title of the next paper, presented by Augustus C Smith, of the Buffalo General Electric Co. Tests on arc furnaces with an Esterline graphic meter were made and very accurate records of the characteristic use of electrical energy were secured. Photographic copies of these graphic records were shown. Many of these reveal great surges which cause serious disturbances in the central station's lines. Mr. Smith pointed out, however, that with a certain amount of care in the operation of the electric furnace the surges can be practically eliminated.

In discussing Mr. Smith's paper Mr. Coe felt certain that abnormally large surges could easily be eliminated by introducing automatic reactors into the circuit. Mr. Noyes outlined the very efficient system of the Detroit Edison Co. in supplying power to various electric foundries. Small substations are located at or near the electric foundry, and these substations are fed by 23,000-volt feeders, entirely separate from the lighting circuits.

The New Laboratory at Harvard.

After a lunch at the Harvard Union the members were taken through the new laboratories at the invitation of Professor Richards, who explained briefly the especial features of the Laboratory, and the precautions that had been taken to fit the rooms for research work, which included thermostatic regulation of all the rooms, double-paned windows and other new features.

After lunch the members of the Electrochemical Society were invited to visit the plant of the Huff Electrostatic Separator Company. A description of the patented process of this company is given elsewhere in this issue.

Labor Turnover of Industrial Plants, and What Steps Can Be Taken To Minimize It.*

By A. W. MACDONALD, Welfare Superintendent Dominion Steel Corporation.

It is only within the past few years that the question of this factor in the labor problem has received very much attention from executives.

When it is realized that labor cost is by far greater than material cost in producing, it behooves companies employing large numbers of men to devise ways and means of reducing the turnover of labor on their plants to the lowest figure possible.

It has to be admitted that the putting to work of new men is one of the most important causes of a high accident rate.

Comparatively few employers have realized that for every man on their pay-roll they are probably hiring at least one new man every year. This shows a labor turnover of 100 per cent and should be a sufficint argument to cause any employer to study the reason for his works labor turnover. Any manager or superintendent of an industrial plant or other works employing large numbers of men, who is still of the opinion that the methods that obtained ten years or more ago are good enough to-day, as far as the hiring and discharging of workmen is concerned, is making a mistake that is costing his company dearly.

It might be well to give some consideration to what it costs a company to make a new employee efficient, that is to bring him from the stage of a "green man" to that of being a productive workman.

Some of the sources of this cost are:

(a) The difference between a standard day's work and that which a new man does while getting used to the job.

(b) The extra supervision required by a green man.

(c) Interference with the work of other men.

(d) Accidents caused by green men.

Various executives have computed the total amount of the costs according to their own conditions, and the results range from $25.00 to $100.00 per man as the cost to a company of bringing a green man up to the stage of a productive workman.

It is evident therefore that the cost of replacing workmen is enormous and the necessity of taking drastic measures to prevent labor turnover is of first importance.

Of course to get rid of an employee is far easier than to help him "make good" and to let him go less troublesome than to find out in advance any condition of dissatisfaction and to attempt to remedy it.

One of the chief reasons why this matter has received so little attention from companies in the past is that they have no records to show what their labor turnover was, and therefore they did not know what it was costing them.

In the last analysis this hiring of men to replace men who have left the employ or, in other words labor turnover, is simply wasting labor, particularly at this time when men are scarce and most companies have already passed from the position of buying labor to selling employment, and it is clearly a matter of sound business for industrial organizations to hold out inducements for capable men to enter their employ, and to fully develop the capabilities of those they get.

The only reason why a company engages in business is to make profits, and any activity of the company that does not tend toward that end is poor business.

Large companies developed slowly from the primitive stage of industry in which each employer was his own foreman, and the tradition has been handed down that in order to preserve discipline the foreman must be able to hire and discharge his own men.

It has been pointed out in a foregoing paragraph that the labor cost of production is very much in excess of the material cost, probably in some instances two and one-half or three times as much, and we find that every company purchases its material through a well-organized purchasing department, while in the majority of cases its labor supply is picked up haphazard. More attention is certainly paid to the purchasing of material and the designing of equipment than to the selection of workmen.

This in no small measure contributes to unrest and dissatisfaction among workmen, and consequently is a dominant factor in labor turnover.

Work of all kinds can be analysed to determine the qualifications necessary for its performance, and in some places efforts are being made by executives along the line of selecting and training workmen, and the time is not far off when this will be a regular part of industrial activitiy. The majority of men are neither lazy nor unwilling to work. The trouble is that they are picked up without any effort at selection and placed at work for which they are unfitted.

The question of hiring and discharging workmen, on which alone rests the labor turnover of a plant, may be placed under two headings:

(1) Hiring and discharging by foremen.

(2) Hiring and discharging through a properly organized Employment Department.

In the first place hiring by the foremen frequently leads to practices that are detrimental to all concerned. It very often leads to the building up of racial and other cliques in a department that will cause trouble later. This is inevitable, as the only source of labor supply that is open to a foreman is through his relatives and friends and the friends of the men in his gang.

The only basis of judgment the foreman has in interviewing an applicant for work is the impression the man makes on him at the time. If the applicant is unknown to him personally he cannot tell anything at all about his ability, and he has not the time or means at his disposal to make the enquiry necessary to even approximately determine the fitness of the man for the work that has to be performed.

We can now consider the centralized hiring of employeees through an employment department.

One of the objections to this method was that it interfered with the authority of the foremen and superintendents. As a matter of fact it does nothing of the sort. It does not mean that they cannot dispense with the services of any man who is not doing his work in an efficient way. Instead of the faulty workman being discharged from the plant to the

---

* A paper read before the Mining Society of Nova Scotia at the Annual Meeting, Glace Bay, N.S., May 4th and 5th, 1920.

street, he is sent back to the employment office, where a further effort will be made to have him placed on a job where he will fit. It is evident that although a workman may not suit one job he may do alright on another one. If after a reasonable number of trials have been made, the man persists in being "no good" he should be discharged. In a modern organization no man should be allowed to leave the service without a searching enquiry into his reasons for doing so. These interviews with men who are leaving the employ frequently reveal objectionable conditions that in many cases can be easily remedied, and that are actually a disadvantage to the company as well as to the workman. The modern employment bureau is the only agency that is equipped to handle the problem of distinguishing between the man who is no good and the man who is wrongly placed.

Certain things are essential to successful centralized hiring of workmen. In the first place the employment manager should be personally familiar with the various works for which he has to secure workmen. He should have notice as far as possible in advance of the number and class of men required, so he can provide them when needed. He should have sufficient assistant so that his time will not be used up doing work that can be equally as well done by an ordinary clerk. He should have the standing and the authority in the organization that will enable him to perform his duties satisfactorily, so that the company for which he is working will get the best possible results.

Summary.

(1) The cost of labor turnover in industry is so large as to justifiy the adoption of any means to bring about its reduction.

(2) The most important and effective method is the establishment of an employment department properly administered.

(3) Hiring through an employment department does not impair the authority of the foreman or superintendent immediately in charge of the work.

(4) He hires his men from the employment department and discharges them back to it instead of to the street.

(5) The employment department is able to give the applicant for work special attention, and properly conducted it is able to devote special skill and knowledge to selling employment in the organization to the workman.

BETHLEHEM STEEL COMPANY ACQUIRES COLLIERIES AND AREAS OF JAMIESON COAL COMPANY.

Another example of the tendency of steel companies to acquire coal areas, noticeable in Canada, in Britain and in the United States is the purchase announced by the President of Bethlehem Steel, who stated recently to his Board:

"The property we have acquired is located only fifteen miles away from the property of the Elkins Coal & Coke Company, recently acquired by the Bethlehem interests. The property consists of about 7,000 acres of coal land, having proved up over 65,000,000 tons of a very good quality of low sulphur gas coal. The property is in operation and equipped to produce 1,000,000 tons of coal annually. The Bethelhem Steel interests are now fully supplied with their full requirements of all kinds of bituminous coal."

THE CANADIAN INSTITUTE OF CHEMISTRY

The Canadian Institute of Chemistry came into being in May, 1919, by vote of chemists of Canada assembled in convention, and shortly after, the first meeting of the original members was called when the following officers and Council were elected:—

President: J. Watson Bain, University of Toronto.

Vice-Presidents: George Baril, M.D., Laval University; Dr. A. McGill, Chief Chemist Dept. Trade and Commerce, Ottwa; R. D. Mc. Laurin, University of Saskatchewan.

Councillors: G. R. Ardagh, University of Toronto, Dr. J. S. Bates, Price Bros., Ltd., Kenogami; Dr. Horold E. Biglow, Mt. Allison University; S. J. Cook, Dept Trade and Commerce, Ottawa; J. A. Mc. D. Dawson, Dept. Trade and commerce, Vancouver,; Dr. L. F. Goodwin, Queen's University; I. Grageroff, Canadian Explosives, Ltd.; A. Lehmann, University of Alberta; Matthew A. Parker, University of Manitoba.

At the present time the Institute numbers 113 Fellows, and three Associates, together with H. R. H. the Prince of Wales, who graciously consented to become an Honorary Fellow.

Mr. Harold J. Roast (393 Guy St., Montreal) is the Secretary-Treasurer.

The Institute represents Canada on the Board of the inter-allied Chemical Union.

The following extracts from the Constitution set forth the objects of the Institute and the qualificaions required for membership:

Objects of the Institute:——

"A" To raise the profession of Chemistry to its proper position amongst the other learned profession, so that it may attract a larger proportion of the best intellects and thereby secure a supply of trained Chemists adequate to the growing industrial needs of the country.

"B" To form an organization immediately available for consultation by the Government.

"C" To protect the public by gathering together a body of men who may be consulted with confidence.

"D" To look after the professional well being of the Chemists by:—

1. Having a registration bureau for Chemists.
2. Having social centres for Chemists and Chemists only.
3. Maintaining an employment bureau for Chemists.
4. Having centres for the interchange of Scientific experience, by both papers and lectures.
5. Maintaining a clearing house of available chemical knowledge, including a library and suitable register that would enable the central bureau to put one Chemist in touch with that other chemist, who might be able to assist him in his particular problems (leaving it to the parties interested to arrange details as to recompense or otherwise).

"E" To secure such Government recognition as may from time to time be deemed advisable.

"F" To maintain a professional association for professional men.

"That the membership consists of two classes: Fellows and Associates, of either sex, the former having the right to use the letters F.C.I.C., and the latter having the right to use the letters A.C.I.C.

"That the following be the requirements for Fellows:—

(a) One who shall be of the age of twenty-five or over, being a graduate of a recognized University, having a four years course in Chemistry or Science, and who can satisfy the Council that Chemistry, Pure or Applied, has been his major subject, and who has been actively engaged in the pursuit of Chemistry in a responsible capacity for two additional years.

(b) One who shall be of the age of twenty-five or over, being a graduate of a recognized University, giving only a three year course in Chemistry or Science, who can satisfy the Council that Chemistry, Pure or Ap-

plied has been his major subject, and who has taken another year's training in Chemistry, at a University, and has had in addition two years experience in Chemistry in a responsible capacity in a laboratory approved by the Council, or under the direction of a Fellow of the Institute. If the additional year at a University is not taken, then three years training in a responsible capacity in a laboratory by the Council.

(c) Those who do not qualify under (a) or (b) being of the age of twenty-five or over, shall have held a position of responsibility in Pure or Applied Chemistry for not less than five years and shall be examined by a Board appointed by the Council. The Candidates shall be examined on the theory and practice of Chemistry with special reference to the branch of Chemistry in which they have been engaged. This examination may be waived at the discretion of the Council if the Candidate was engaged in Chemistry at the date of the inauguration of the Association and has held a position of professional responsibility for not less than eight years.

"That the following be the requirements for Associates:—

Persons being under twenty-five years of age who would otherwise be eligible for membership as Fellows under provisions, a, b, and c, the requirements under a and b regarding the practice of Chemistry in a responsible capacity for two years being waived.

"An Associate upon reaching the age of twenty-five years may become a Fellow providing he is recommended by three Fellows and has been engaged for at least two years in the practice of Chemistry pure or applied, and is otherwise eligible as a Fellow.

"An Associate upon election to a Fellowship shall pay the difference between the initiation fee for Fellows and Associates.

"The Council reserve the right to refuse admission to any applicant, or ot remove any member for sufficient cause.

Fees:—The entrance fee for Fellows be Ten Dollars and Annual Fee Ten Dollars.

The Entrance for Associates be Five Dollars and the Annual Fee Five Dollars.

DR. SORBY OF SHEFFIELD, ENGLAND.

Pioneer of Microscopic Examination of Rocks and Metals.

At a symposium held in London, England, by the Faraday Society, the Royal Miscroscopical Society, the Optical Society, and the Photomicrographic Society on the design and uses of the microscope, fitting tribute was paid to the magnificent pioneer work of the late Dr. Sorby, of Sheffield. It was Sorby who first hit upon the notion of studying the structure of rocks by cutting thin slices and examining them under the microscope. In the face of ridicule he continued his experiments until he founded the science of microscopic petrography. When he turned his attention to the structure of meteorites, he found it impracticable to obtain thin sections and accordingly he developed the plan of etching a polished surface with acid and examining it microscopically under reflected light. Thus he gave birth to the microscopic study of iron, steel and other metals—a study which has been of incalculable benefit to industry. One remarkable fact about this British genius is that he did all his work in a private room in his house, with only the simplest materials. As Sir Robert Hadfield remarked at the symposium, "from the humblest of beginnings this method of research has grown into a giant."

The foregoing tribute to the late Dr. Sorby, of Sheffield is from the South African "Mining and Engineering Journal". Dr. Sorby's memory is perpetuated in the "sorbite" constituent of steel, and is also fresh in the recollections of those who remember him in his old age at Sheffield University. Dr. Sorby, among other things, was an authority on deep-sea organisms, and on Egyptology.—Ed.

THE HUFF ELECTROSTATIC SEPARATOR.

At the recent meeting of the American Electrochemical Society in Boston, opportunity was given to the members to visit the testing and demonstration plant of the Huff Electrostatic Separator Company at Arlington Heights, near Boston. The Huff separator uses electric current of high voltage and low amperage to separate mixtures of dry materials having different electrical conductivities, either by repelling part of the material vigorously, or allowing part of the material to be electrically released more quickly than the rest when passed over an electrode.

Some of the materials shown to the visitors in original form, and as concentrates and tailings, included garnetiferous sands, fine anthracite coal mixed with sand and dirt, graphite ore, micaceous rocks, molybdenite ore, abrasives, aluminum slag, barytes and lead ore, and, amongst other things a mixture of ground automobile tires separated into rubber and cotton particles.

While the electrostatic separation process has admitted limitations there would appear to be a wide field for its use because of the exactness and nicety of the separation, the small and inexpensive plant required, and the comparatively small power cost. For the separation of graphite the process seems excellently well adapted, as a comparison of the flaky and unctuous-feeling product of electric separation with Ceylon "chip" revealed. For separation of minerals contained in sands the process is well adapted, as it is also for the separation of abrasives from sands, or form the dross of artificial abrasive manufacture.

The usefulness of this method of separation in connection with any given natural or artificial mixture of materials cannot be determined with any exactness except by actual testing, but trial with a small sample will enable an opinion to be given as to the suitability of the method in each case, and the Huff Company state it has not been required to dismantle, as yet, any plant which was recommended for ore-dressing by its engineers as the result of tests.

BRITISH ENGINEERING FIRMS TO USE CANADIAN SHOPS.

Albert George Hill, sales manager of the Bawden Machine Company, Limited, Toronto, returned to Canada a few weeks ago after spending the greater part of a year in England where he made arrangements for the Canadian selling rights for Alley and MacLellan, Limited, Glasgow, Scotland, manufacturers of air compressors, valves and water works supplies, and the sole license right to manufacture and sell in Canada the products of the following English and Scotch firms: Robey and Company, Limited Lincoln, England, manufacturers of semi-Diesel oil engines, steam engines, air compressors and mining machinery; John Thompson, Limited, Wolverhampton, England, manufacturers of corrugated furnaces and water tube boilers; David Bridge and Company, Limited, Castleton, Manchester, England, friction clutch rubber and textile-working machinery, E. S. Hindley and Company, Limited, Bourton, Dorsetshire, England, makers of high-speed steam engines, Brown Bros. and Bow, MacLachlan, Limited, manufacturers of steering gears and steam-boat auxiliary machinery. The Bawden Machine Company will manufacture all parts of the English machinery and will supply repair parts.

STELLITE

By ELWOOD HAYNES.*

A Paper presented at the meeting of the American Electrical Society, Boston, April 10th, 1920.

Realizing many years ago that an alloy that would take a cutting edge and at the same time resist the action of the atmosphere would fill a long-felt want, I made attempts even then to produce such a mixture or combination of metals. I found, however, that the problem was beset with many difficulties. Alloys containing copper were always subject to the tarnishing action of moist air and sulphuretted hydrogen; mixtures containing nickel and copper only possess the same disadvantages, though to a limited degree. Aluminum alloys with copper and nickel gave considerable hardness and a very high elastic limit, but they would tarnish in moist air, particularly in the presence of hydrogen sulphide.

In 1891 I made an alloy of nickel and tungsten, and, while this was not immune to acids, it resisted atmospheric influences remarkably well. This alloy was made by melting pure tungsten and pure nickel in a small crucible composed of a mixture of pure alumina and pure magnesia. The fusion was made in a small furnace of my own construction. The fuel used was natural gas, using air blast from a small foot-bellows.

Later, in 1898, I produced pure alloys of nickel and chromium by the reduction of their mixed oxides with pure aluminum. The alloy of nickel and chromium thus formed took a high polish, and retained its luster in boiling nitric acid when the chromium constituted more than twelve to fifteen per cent of the alloy. This alloy could be filed rather readily, and could be worked cold into rods and sheets if sufficient care was exercised.

I next produced an alloy of cobalt with chromium in the same manner, but when the reaction took place a certain amount of free oxygen was evolved, and the metal was thrown from the crucible. This was due to the fact that the higher oxide of cobalt (Co_2O_3) was used, while in the former experiment NiO was employed.

The reaction for the production of the nickel alloy was as follows:

$$3NiO + Cr_2O_3 + 2Al_2 = Ni_3Cr_2 + 2Al_2O_3.$$

The reaction in the case of cobalt was:

$$2Co_2O_3 + Cr_2O_3 + 3Al_2 = Co_4Cr_2 + 3Al_2O_3.$$

It is obvious that by varying the proportions of the various oxides, alloys of varying compositions can be obtained.

It was only a step from this reaction to the production of the alloy by the simultaneous reduction of the oxides of their constituent metals by means of carbon.

Afterwards, they were produced on a commercial scale by melting pure nickel or pure cobalt with chromium. Since the cobalt-chromium alloys possessed great hardness and could be worked at a bright red heat, it seemed to be the more promising field for further investigation, and when, in the early part of 1900, large quantities of cobalt ore were discovered in Canada and it became possible to procure the cobalt oxide at a comparatively reasonable price, I decided to place the alloy on a commercial basis.

The discovery of these alloys was first made public at a meeting of the American Chemical Society, in San Francisco, in 1910.

About this time I discovered that by adding tungsten or molybdenum to the cobalt-chromium alloy its hardness could be very much increased, though the addition of either of these metals in any considerable quantity rendered the alloy unworkable either hot or cold. It could, however, be cast into almost any desired form, and when cast bars were ground to a cutting edge and placed in the tool-holder of a lathe, the alloy at once showed a considerable advantage over high-speed steel as a lathe tool.

The first remarkable test of this sort was made in the machine shop of the Haynes Automobile Company. A large boring mill had been purchased for boring cylinders. This mill was supplied with a boring head in which were inserted small radial cutters which bored out the interior of the cylinders directly from the rough castings. I was informed by our superintendent that he had found it impossible to work the mill to more than half its rated capacity on account of "burning" the steel tools. We had up to that time made only a few tests on the lathe of Stellite tools, but he was very anxious to try the alloy in the form of boring cutters. I accordingly produced a set of cutters of Stellite, which were inserted into the boring head. When I came to the factory the next day, about 11.30 in the forenoon, I asked the man at the mill what success he had achieved, and he replied that he "had a day's work out at twenty minutes of eleven in the forenoon." In fact, he was boring more than twice as many cylinders in a day with Stellite tools as could possibly be bored with steel ones. This test fully demonstrated the practical utility of Stellite tools.

In 1912, another paper was read on this alloy in New York, at one of the sessions of the International Congress of Applied Chemistry.

It was found quite difficult to make metal of uniform texture and quality in the form of castings, but most of the difficulties have been overcome, and we are now placing upon the market cast tools of various kinds made of Stellite, which are of standard quality both as to strength and hardness.

The alloys are made almost entirely in electric furnaces of the Snyder type. The materials composing the alloy are placed in the furnace in the usual manner, and the current turned on. The alloy fuses rapidly, without much oxidation, under the intense heat of the electric arc. We find that of the metals composing the alloy, chromium is most readily oxidized, while cobalt seems to show more volatilization, and tungsten is subject to the least change. It is true that the portion of furnace above the metal becomes filled with nearly pure carbon monoxide. This gas will oxidize chromium under certain circumstances at very high temperatures, though apparently no free

* President, The Haynes Stellite Co., Kokomo, Indiana.

carbon is produced in the furnace. This is probably because there is sufficient free oxygen or carbon dioxide to re-oxidize any carbon that may be temporarily produced.

At first much difficulty was experienced with the electric furnace linings, but after a certain amount of experimental work we were able to produce a magnesite lining which gives most excellent satisfaction in practice. When we first began the use of these furnaces, we considered ourselves fortunate if we could get eight or ten melts without either complete relining or heavy repairs. We now commonly obtain from two thousand to three thousand melts from a single lining, and some of them stand even higher than this.

The electric arc, on account of its extremely high temperature, causes a certain amount of volatilization or oxidation in the melting of many metals, but Stellite withstands the conditions remarkably well, particularly after the fusion is once made. In melting scrap, however, if certain precautions are observed only a very slight loss is experienced in re-melting. Stellite can be melted in covered crucibles under suitable precautions with a loss of less than two per cent, and sometimes it does not even reach one per cent.

Not only have the Stellite alloys containing cobalt, chromium, and tungsten, or cobalt, chromium, and molybdenum shown great economic advantage as lathe tools but the binary alloys (consisting of cobalt and chromium only) have likewise received a wide application in the form of dental instruments surgical instruments, pocket knives, etc.

A modified Stellite alloy, known as Festal metal, consisting of cobalt, iron, and chromium, is also manufactured into table knives, which give excellent results in service.

All of the above alloys are practically immune to all atmospheric conditions, whether the air be moist or dry, or whether it contain minute quantities of sodium chloride or sulphuretted hydrogen. Knives made of this alloy can be used for cutting all sorts of fruit, including lemons, oranges, apples, etc., without becoming discolored in the slightest degree. A new and interesting application of malleable Stellite is as a substitute for gold in the manufacture of pen points for fountain pens. The tips of these pens may if desired, be made of extremely hard Stellite, which can be welded to the malleable alloy. This application is particularly gratifying because the metals replaced, gold and iridosmium, are exceedingly expensive.

ANNUAL MEETING OF ONTARIO SAFETY LEAGUE

The sixth annual meeting of the Ontario Safety League will be held on Tuesday, April 13, at 9.30 a.m., following which will be a three day safety convention in the Banquet Hall of the King Edward Hotel, Toronto. Mr. J. T. Burke, Chief Inspector of Factories, chairman of the sub-committee on papers, is arranging for papers on steam railroad hazards; elevator accident prevention in the pulp and paper industry; industrial dust; accident prevention in the rubber industry; plant sanitation; resuscitation; woodworking hazards; accident prevention in the steel industry; grinding wheels; hazards in grain elevators and cereal mills; accident prevention in the automobile industry; shop lighting; public utilities; shop saftey committees and industrial relations and fire prevention, by men prominent in industry throughout the country.

ONTARIO SECTION OF A. S. MECH. ENGINEERS ENTERTAINED BY FAIRBANKS-MORSE CO.

The Ontario Section of the American Society of Mechanical Engineers held one of the best meetings of the season on Thursday, April 8th, when they were the guests of the Canadian Fairbanks-Morse Company, Limited, at their Bloor Street West plant. While they did not exactly make "a night of it," it was only because proceedings started early. The programme began at 4'clock with a trip through the manufacturing department of the Fairbanks plant. This plant manufactures marine and stationary gasoline engines in several small and medium sizes. The visiting members and their friends found much to interest them in the work in process and the methods in the shop.

At 6 o'clock the company entertained the entire party at dinner in the new club room on the top floor of the main building. These club rooms with the cafeteria on the floor below are a part of the general welfare scheme of the company, and are just now open. In fact, our meeting was, in a sense, a house-warming for the club rooms, as Mr. Watkins explained.

At 8 o'clock the meeting was called to order to listen to a paper by Mr. B. P. Graves, designer of milling machines for the Brown and Sharpe Manufacturing Company, Providence, R.I. His subject was that nearest his heart, namely: "Milling Machine Design," and he spoke of this subject with the authority and naturalness of one who has grown up with it. The lecture was illustrated with lantern slides, and was followed by a very interesting discussion which became, at times, quite of a detailed nature.

In the absence of Professor Angus, the Chairman, Mr. Watkins, of the Fairbanks Company, was both presiding officer and host.

QUEENSLAND STATE IRON AND STEEL WORKS

In the Legislative Assembly of Queensland, the Premier, Mr. Theodore, announced that the Government had determined upon the site for the projected State steel and iron works. That site is Bowen. The people of Bowen may be congratulated, for it means that the town should eventually become one of the great industrial centres of Australia. In many respects it is admirably situated for the purpose of iron and steel manufacture—and the opinion of the expert, Mr. Brophy, formed after having made exhaustive researches, is that it is the best place in Queensland for the establishment of the works. Mr. Theodore informed the Assembly that an early start will be made with the preparation of the site of the works and obtaining the necessary machinery; and it is understood that his projected visit to England is largely concerned with the financing of these works. It is estimated that the cost will be approximatively £2,500,000, and to meet this it is proposed to float a special loan in London. We may expect, however, that those disposed to lend money to the State for such an enterprise will insist on a guarantee that the works will be managed in a more business-like way than other State enterprises in Queensland, most of which have proved burdens to the people.—"Australian Industrial Standard."

British Columbia Government Considering Establishment of an Iron and Steel Industry by the Province

Private individuals contemplating establishment of Iron and steel manufacture require such substantial Government guarantees that works owned by Province seem preferable to financing private enterprise

The Hon. Wm. Sloan, Minister of Mines for British Columbia, in an address on the second reading of the Bill to extend the operative period of the Iron Ore Bounties Act until 1925, said with reference to the much debated possibility of an iron and steel industry in the Province:

"That the Government has received many applications from various quarters for substantial support in the launching of this industry. All these applications have been given careful consideration, but in every instance it has been found that the individuals or corporations concerned, required that the Government enter into financial responsibilities of a very serious nature, in many instances to the full financial requirements of the enterprise. This, it will be appreciated, would involve a binding obligation not lightly to be undertaken under the conditions with which the Province has been faced during the past few years. For this reason consideration has been given the question of whether it would not be the best policy of the Government itself to lead the way to the establishment of an industry for the manufacture from our iron ores of commercial iron and steel rather than finance private enterprise to do so.

Province will take the initiative..

"It is proposed therefore," continuld the Minister. "that should no more favorable terms be submitted by private enterprise to assemble full and complete data, having special reference to the recent important discoveries of hematite ore in the Whitewater district, all with a view of considering the undertaking by the Government of the establishment of an iron and steel industry at an early date in the Province of British Columbia, thereby paving the way to the obtaining for our Province what is recognized as the basis of all industrial enterprise."

Government is Determined to Grant Every Encouragement to Iron Industry.

"The bill before the House," he continued, "is merely one of a series of measures each of which, directly or indirectly, has the same object. Others that may be instanced are the Mineral Survey and Development Act and the Iron Ore Supply Act of 1919. The former furnishes the machinery through which more detailed and accurate information regarding our mineral resources—and our iron ore bearing areas are in an important part of these resources—may be obtained. In passing I may say that it has served and is serving this purpose."

By those who had been and were concerned in the establishment of an iron and steel industry Mr. Sloan wished it to be understood that the Government was behind them to the full extent of its power having regard to the serious financial obligations of the country and to its responsibility as the representatives of the taxpayers and electors of the country. The Government was sincere in its determination to help those whose enterprise and confidence in the future of the Province had induced them to take up the task of launching the industry which, everybody was agreed, would mean the opening of a new, a broader and a more prosperous era in the commercial and industrial development of British Columbia.

The Whitewater Discovery.

"Possibly the most noteworthy of recent events bearing on this subject," recalled Mr. Sloan, "is the discovery of large deposits or what are described as limonite and hematite ores in the Whitewater River section of the Lillooet Mining Division. When information was received regarding the existence of these bodies of iron ore Wm. M. Brewer, one of our mining engineers, was instructed to proceed to the district to make an examination and submit a report thereon. This he did last summer. While Mr. Brewer was unable to make a full and complete inspection he was able to see and to satisfy himself of enough to demonstrate that the field merits the very closest examination in the public interest. Mr. Brewer places himself on record as estimating the 'actual ore' at 7,200,000 tons, the 'probable ore' at 15,000,000 tons, and the possible ore' at 50,000,000 tons. Assays of the ore show it to be of high commercial value.

Steps Taken.

"Recognizing the importance of such a deposit," said the Minister, "the Department of Mines immediately took steps to interest the Geological Survey of Canada. Through Charles Camsell, its western representative, the services were obtained of S. J. Schofield, who proceeded to the district to make a further report. His party, however, was too late to make any extensive investigation. In the meantime, through the instrumentality of the Department, a reconnaissance of possible route of transportation from the Whitewater District to the coast has started, having been partially completed last season. It will be continued this year.

Further Work Promised.

"This work," Mr. Sloan went on, " both in regard to the geology of the section, the extent and quality of the iron ore available, and as to the feasibility of arranging transportation facilities, will be proceeded with this year as soon as conditions permit. The assurance of the Geological Survey has been received that although hampered by a shortage of properly qualified geologists, every effort will be made to assign a party for exploration in this section during the Summer months.

"It is scarcely necessary," he said, "for me to emphasize the importance of such a deposit of accessible Hematite and Limonite ore to British Columbia. If all is as represented it means that the establishment of blast furnaces in this Province, is as practical as it has been found in any other industrial centre of the American continent. In short it simplifies the problem of the treatment of the Magnetite Ores of the Coast and brings the establishment on a firm and lasting basis of an iron and steel industry within easy reach of those with capital looking for a sound investment that will assist at the same time in the opening up and the development of the country.

Progress Has Resulted From Government's Action.

"Broadly speaking," the Minister concluded, "we are, unquestionably, some distance further ahead towards the solution of the problem of the development of the iron ore resources of the Province. The Government has not lost sight of the importance of the question and is using every means possible to bring about the result so fervently desired. With our policy of obtaining more information regarding the deposits at our disposal, of bonuses, of assisting those undertaking experiments in treatment, and lastly of obtaining from the Legislature the power to prevent the tieing up of such holdings for speculative purposes, we may expect action soon."

CEMENT-COATED NAILS.

The inventive brain of an American genius has prompted the covering of wire nails with a kind of resinous material which for some reason is termed cement, and although these have only recently been introduced these "cement-coated nails," as they are known, are becoming remarkably popular. It appears that quite 10 per cent of the total American production of wire nails are cement-coated, and it is believed that in course of time nails of the ordinary variety will become obsolete.

The new nails possess remarkable holding power, a property due largely to the cement and tests have shown that one of the new nails has the same holding power as two of the French or oval wire nails generally used in this country and on the Continent.

The compound with which they are covered consists principally of resin, probably with the addition of a little suitable ail to prevent undue cracking and peeling off. the coating is applied in a "tumbling" barrel, which, heated to a fairly high temperature, is half filled with hot nails and powedered compound and tumbled for a few minutes. The new nails are made of thinner wire than the ordinary type, and as a general thing run a trifle shorter than standard size. The chief drawback to these nails is that the coating is liable to splinter off, and they are also difficult to remove when used for temporary work.—"Financier & Bullionist."

ALGOMA STEEL CORPORATION.

In a circular to the shareholders the unfilled orders at the end of March is given as 402,000 tons. The production for the nine months ending March 31st compares with the corresponding period of last year as follows:

	1919-1920. Tons.	1918-1919. Tons.
Steel ingots	223,832	369,848
Pig iron	199,558	280,664
Coke	303,611	330,063
Ore (Magpie)	180,761	156,732

A plan of reorganization of the finances of Algoma Steel Corporation, as one of the subsidiaries of the Lake Superior Corporation, is under submission to the shareholders.

Company Notes

DOMINION BRIDGE COMPANY.

Proposed Expansion of Subsidiary to Manufacture Hydraulic Machinery at Lachine.

A circular to the shareholders of the Dominion Bridge Company has been sent out, reading as follows:—

In the report of your Directors of the operations for the financial year ending October 31st, 1919, which was submitted at the Annual Meeting, 14th of January, 1920, reference was made to your subsidiary, the Dominion Engineering and Machinery Company, Limited, in the following terms:—

"The demand for paper-making machinery, alluded to in the last report, has outgrown the capacity of your shops at the Lachine works, where its manufacture was being carried on, and your company has purchased the land and shops of the St. Lawrence Bridge Company (built for the fabrication of the Quebec Bridge). A foundry equipped to turn out the special castings required for paper-making machinery and also for the heaviest class of general castings has been added. The tools and machines now used for making paper machinery are being transferred from your works to the new plant and the shops of that plant are generally being equipped for the manufacture of paper-making machinery, as well as for special foundry and machine shop products for which there is not now capacity in Canada.

"It was considered advisable to segregate the operations of the new plant from your company and to incorporate a new company under the name Dominion Engineerig ad Machinery Company, Limited, to take over the shops and equipment, the paper machinery business and other business for which these shops would be specially equipped, with an issued capital of $2,500,000. Your company has acquired all the shares of the new company."

Since the above report was made your directors have been in negotiation with the representatives of several important power companies which must soon make large additions to their installations of hydraulic machinery and which were considering the establishment of shops for the construction of this machinery in order that they might obtain their own requirements in Canada, and they also had in view the commercial manufacture of hydraulic machinery for others as well as general heavy foundry and machine shop business.

These interests after inspection determined that the shops of the Dominion Engineering and Machinery Company and part of its facilities which have already been provided could be used to advantage for the manufacture of hydraulic machinery, needing only the addition of special equipment and increased working capital, thus saving the heavy investment necessary to duplicate the foundry and existing plant facilities of the Dominion Company and permitting the manufacture of water wheels and their accessories to be started almost immediately.

Your directors consider it would be an advantage for your subsidiary to form this alliance because it associates important interests with the company and promises additional profitable work for the plant which can be undertaken with a comparatively small increase in overhead expense.

A new company, the Dominion Engineering Works, Limited, is being incorporated with an authorized capital stock of $5,000,000, 8 per cent cumulative redeemable preferred shares and $5,000,000 of common shares of which $4,000,000 of the preferred and $4,000,000 of the common is now to be issued.

It is proposed, subject to your approval, that the Dominion Engineering and Machinery Company, Limited, will sell its undertaking as a going concern, receiving in payment therefor a majority of both the preferred and common shares, now to be issued, of Dominion Engineering Works, Limited, which will give your company a stock controlling interest therein, the balance of the $4,000,000 preferred and $4,000,000 common shares will be issued on such terms as will provide the company with sufficient working capital for its requirements and to cover the cost of installation of such additional plant and machinery as may be necessary for the extended operations of the company.

The Dominion Engineering Works, Limited, will enter into an agreement with the Wm. Cramp and Sons Ship and Engine Building Company, for the exclusive use in Canada and the British Empire of its designs for water wheels and other hydraulic machinery. The Water Wheels Department of the Wm. Cramp Company has constructed most of the large water wheels in Canada, aggregating 658,000 h.p., including 101,000 h.p. for the Montreal Light, Heat and Power Company; 137,000 h.p. for the Shawinigan Water and Power Company and 120,000 h.p. for the Laurentide Company.

The following gentlemen have consented to join the Board of the new company:—Sir Herbert Holt, Pres. the Montreal Light Heat and Power Company; Geo. Cahoon, Jr., Pres. The Laurentide Company; Julian C. Smith, Gen. Mgr. and Chief Engineer Shawinigan Water and Power Company; Howard Murray, Vice-Pres., Aldred and Company; H Birchard Taylor, Vice-Pres., Wm. Cramp and Sons, Ship and Engine Building Company.

Your directors feel that the above gentlemen on the directorate will be an added strength to the new company, and strongly recommend for these and other considerations that you authorize the carrying out of the transaction.

STEEL COMPANY OF CANADA.

At the Annual Meeting of the Steel Company of Canada, held in Toronto, April 26th, the officers of the company were re-elected without change, as follows:

Chairman of the Board, C. S. Wilcox; President, Robert Hobson; Vice-Presidents, F. H. Whitton and Ross H. McMaster; Secretary-Treasurer, H. H. Champ; Asst. Treasurer, H. S. Alexander; Asst. Secretary, Corbett F. Whitton; Directors, Cyrus A. Birge, A. G. Brown, Lloyd Harris, Hon. John Milne, Sir Edmund Osler, and Sir Thomas White.

The President announced that a light-oil recovery plant was to be provided at the coke-ovens.

Montreal—

J. L. Lemieux, for six years associated with Lymburners, Ltd., as mechanical superintendent, has opened the Modern Machine Works at 83 Bleury Street Montreal and will do general machine shop work. He will also be in a position to take care of special work, such as the designing and building of machine tools, experimental work, etc.

Organized for the purpose of assembling automobiles in Canada, the Forster Motor Car and Manufacturing Co. Ltd., Montreal, Que., has a capital of $1,000,000, divided three-fifths preferred and the remainder common. The company has purchased a plant having an annual capacity of 800 cars in Maisonneuve, a suburb of Montreal. It also has purchased the adjacent land on which it contemplates building a modern motor car factory late in 1920. A contract has been closed with Messrs. Southgate, Ltd., London, England, for 10,000 chassis, worth $16,500,000 to be delivered within 10 years. This company has the agency for this car in Great Britain, Ireland and India and will build its own bodies.

Bearing Metals, Ltd., recently incorporated with offices in room 316, Dominion Express Building, has acquired the plant of the Lion Metal Co., Cote St. Paul, Que., and will manufacture babbitt metal, solder, etc. E. L. W. Saunderson formerly manager of the Magnolia Metal Co., will be in charge.

The Dominion Welding Mfg. Co., 584 St. Timothee Street, has acquired the plant of the Belanger Foundry Co., 340 Amherst Street which it will occupy immediately. The company will manufacture instantaneous water heaters and will also continue general welding work.

Toronto—

Eustace G. Bird, architect, 6 King Street West, Toronto, is receiving bids until April 26 for the erection of a manufacturing building at the corner of Wallace and Ward Avenues, for the Canadian General Electric Co., Ltd.

The Anthes Foundry, Ltd., 64 Jefferson Avenue, Toronto, will build addition to its foundry and install new equipment.

The Lennard Machine Tool Co., Ltd., Toronto, has been incorporated with a capital stock of $40,000 by Henry B. Hudson Robert E. Grass, 157 Bay Street; Alexander S. Lown, room 12, 26 Adelaide Street West, and others to manufacture machinery, tools, etc.

The Canadian Tygard Engine Co. will build a carburetor plant in Toronto to cost $40,000. H. R. Watson, 907 Excelsior Life Building, is the architect.

Guelph, Ont.—

The Commercial Motor Trucks, Ltd., the Canadian branch of the Commerce Motor Car Co., Ltd., Detroit, Mich., will establish a branch factory in Guelph, and plans have been prepared for the erection of a plant. Construction will start at once, and operations are expected to begin next October. It is the intention of the company to purchase locally many of the parts which will be required for assembling the motor trucks. The directors of the Canadian company are: Walter E. Parker E. M. Baker, Charles L. Granger, George D. Cox, all of Detroit, and J. M. Taylor, F. E. Pantridge and J. E. Carter, Guelph. The plant will be constructed on a site of 25 acres, opposite the Moncrief Furnace Co., on the York Road.

The T.. Eaton Co., 190 Yonge Street, Toronto, owner of the Guelph Stove Works, has had plans prepared

by W. A. Mahoney for an addition to the foundry, 80 x 200 ft. A new cupola will be built and considerable new machinery will be required. A new office building will also be erected. When the improvements are completed, about 140 additional men will be employed.

Paris, Ont.

The McFarlane Engineering Co., will convert its plant used during the war in the production of munitions into a grey iron foundry There will be two cupolas with a production of 20 tons daily. The company also proposes to go into the manufacture of wood-working machinery, and certain lines of machine tools and specialties.

St. Catharines, Ont.—

Production of drop forge dies and tools has been undertaken by the Kimber & Hillier Manufacturing Co., that has been organized recently in St. Catharines. Trimming dies, punching and bending tools are the other lines being turned out.

Manufacture of wire wheels for motor cars is being undertaken in St. Catharines by the Ajax Wire Wheel Corporation of America that has bought a site and is proceeding with the erection of a brick and concrete factory.

Power Specialty Co., manufacturers of superheaters for locomotives and marine boilers, with head office in New York, have purchased a two-acre factory site in St. Catharines adjoining the Turnbull Electro Metals plant. A plant with 6,000 feet of floor space is being erected this year, and a foundry will be built later. The company expects to have a pay roll of $25,000 for the first year.

The Ealton-Carlson Co., recently incorporated with a capital stock of $400,000 to manufacture mechanics' tools and drop forgings, etc., is establishing a plant. Most of its machinery has been ordered, but it is expected to be in the market shortly for punch presses, drop hammers, etc. The officers are: A. T. Baker, president; Walter Carlson, vice-president; S. G. Walton, secretary and manager.

Windsor, Ont.—

The Victor Motors, Ltd., has been incorporated with a capital stock of $1,000,000 by Joseph Neff and Louis Genest both of Detroit, Mich.; Arthur B. Drake, Anson H. Foster and others, Windsor, Ont., to manufacture gasoline engines, motors, parts, machinery, etc.

Hamilton, Ont.—

The Brown Boggs Co., Ltd., will build additions to its foundry which will more than double the present output. The installation will eventually include a 25-ton traveling crane.

Woodstock, Ont.—

The Standard Tube & Fence Co., Hunter Street, Woodstock, Ont., will build an addition to its plant to cost $30,000. W. Moore is manager.

Brockville, Ont.—

The plant of the International Metal Works is being enlarged by the addition of approximately 8,000 square feet of floor space to provide for additional production of automobile sheet metal parts. Manufacture of motor car bodies is also being carried on by this company.

Galt, Ont.—

The Elliott & Whitehall Machine Co. has secured a site in Jackson Park and will erect a factory, construction to be started immediately. The ratepayers of the city passed a by-law granting the company a loan of $20,000.

Peterboro, Ont.—

The Canadian General Electric Co. will erect an addition to its plant at Peterboro and install equipment at a total cost of $500,000.

Orillia, Ont.

Electric steel castings will be produced by the company that is taking over the operation of the electric furnace erected at Orillia during the war. This equipment was used during the war for the production of low phosphorus pig iron from shell turnings, together with other furnaces in St. Catharines, Hamilton, Toronto, Montreal, Shawinigan Falls, Vancouver, and elsewhere. The furnace at Orillia is of five-ton capacity. It was capable of turning out approximately 700 tons of phosphorus pig per month. Since November, 1918, this equipment has been standing idle.

Welland, Ont.—

The Canadian Mead-Morrison Co., Welland, Ont., manufacturer of steam electric and gasoline hoists, dredging machinery, conveyors, etc., is making preparations to extend its plant and increase production.

The board of directors of Canada Foundries & Forgings, Ltd., has decided to proceed at once with an expansion of facilities at its Welland, Ont., plant, which will greatly increase the output of heavy drop forgings. It also contemplates further extensions to meet the growing demands of Canadian automotive industries.

Reorganization of the Volta Manufacturing Co. of Welland, involves no change in the personnel of that organization. The company has taken out a new charter, with a capitalization of $1,200,000. Electric furnace regulators and other equipment are in greater demand in Canada. There are quite a number of inquiries from companies that are considering the installation of electric furnaces. Export business is in prospect as well.

Walkerville, Ont.—

A company has been organized in Walkerville for the manufacture of motor trucks of 2½ tons carrying capacity. A plant formerly owned by the Gramm Company has been secured and production is likely to commence early in May. The organization is incorporated as the Gotfredson-Joyce Corporation, Limited. An output of 1,000 trucks is aimed at in the first year.

Walkerton, Ont.—

Messrs. Larson & Shaw's stamping works in Walkerton, Ont., is a recent addition to the industries of that town which is fast developing into a very promising business enterprise. At the present time they are working both night and day shifts in order to catch up with their orders, and considerable additions to the working staff will likely be made shortly. The firm are manufacturing special hardware products in copper, brass and aluminum and also turn out ferrules, washers, bronze and copper castings, while considerable attention is being devoted to electrotyping.

Niagara Falls, N.Y.—

The Carborundum Co., Niagara Falls, N.Y., will spend approximately $500,000 in extending its local plant and its furnaces at Niagara Falls, Ont., and Shawinigan Falls, Que. Work will begin at once.

Hull, Que.—

The Hull Iron & Steel Works, Hull, Que., is having plans prepared by Millson & Burgess, 209 Sparks Street, Ottawa, Ont., for the erection of a foundry.

VANADIUM

Its Occurrence and Utilization.

(Abstracted from a paper on the Development of Ferro-Vanadian Metallurgy presented at the Boston Meeting of the American Electrochemical Society, April 10th, by B. D. Saklatwalla, General Supt. of the Vanadium Corporation.)

We will discuss briefly the technical evolution of the processes of reduction, and the general properties bearing on such processes, of an element which up to only a few years ago was characterized as a chemical curiosity, a so-called rare element. Following a recognition of its useful properties, this element, "vanadium," was suddenly converted from its laboratory obscurity into a commercial necessity of far-reaching importance. In this commercial evolution it resembles, to some extent, the element aluminum, which was similarly transformed from an element of chemical catalogs into a metal of everyday necessary technical domestic use. Vanadium, like aluminum, destined to be a great engineering factor, was known to exist, and its chemistry fairly well developed, years ahead of its actual entry into commerce.

This neglect of its usetul properties was due to various substantial reasons. In the first place, its technical uses were limited until Prof. Arnold's researches conclusively proved its value in the manufacture of steel; hence there was very little incentive for its technical development. In the second place, though its presence was widely manifested, it was of rare occurrence in a commercially workable deposit. Vanadium had been classed among the rare elements, with very little justification. It was not the distribution of the element, but its occurrence in a concentrated form at one locality that was lacking until the discovery of the Peruvian deposits in the Andes, near Cerro de Pasco, by Don Antenor Rizo Patron, in 1905. In fact, vanadium is one of the most widely distributed elements on the face of the earth. It is diffused through all primitive granites and many sedimentary rocks and clays. Besides forming a number of special minerals, its presence has been proved, as accompanying other elements, in at least fifty different minerals. In large amounts it occurs in lead ores, and in very small quantities in iron and copper ores. It is found in the ashes of very many coals and various plants. Its distribution as to locality also is not restricted, none of the continents of our globe being free from it. To get an idea of the quantity of vanadium contained in our globe, Vogt comes to the conclusion from various quantitative determinations in minerals, that the entire crust of the earth would show an average content of between 0.0025 and 0.05 per cent vanadium. Further, the presence of vanadium is no restricted to our planet alone. Sir Norman Lockyer has shown its presence in the spectra of various heavenly bodies. Also a number of meteorites have been shown to contain vanadium.

The history of vanadium is more than a century old. It was discovered in 1801 by Manuel del Rio, in the lead ores of Zimpan in Mexico, but was considered by Collet Descotils, who analyzed these ores in Paris, to be identical with chromium. Thus del Rio's discovery was forgotten, until Sefstroem, in 1830, rediscovered the element in iron produced from certain Swedish ores. Then Woehler, taking up the analysis of the Mexican lead ores investigated by del Rio, conclusively proved that Sefstroem's new element was the same as that found by del Rio., viz., vanadium. This controversy inspired Berzelius to investigate the chemistry of this new element in a most thorough manner. It will not be too much to say that the foundation on which the chemical knowledge of this element is erected is formed by the work undertaken by this old master in 1831. Comparatively little was added to it, until Sir Henry Roscoe, about 40 years later, through his researches from 1867-1870, furnished additional valuable data. The first suggestion of technical application of vanadium to metallurgy carries us back to the year 1863 when Lewis Thompson expressed the idea of vanadium having a similar effect to nickel on iron, since it was found in iron of remarkably ductility. A year later, Edward Riley suggested the extraction of vanadium from pig iron, which being analyzed by him, seemed to contain this element.

The treatment of vanadium-bearing materials and minerals can be said to have started following Roscoe's work in 1867-1870, when vanadium found application in the dyeing and ceramic industries, but it was not until 1896 that its entry into metallurgy can be said to date. In that year the Firminy Steel Works in France experimented with the use of vanadium in armor plates. However, the superiority of vanadium steels cannot be said to have been established until the year 1900, especially by the comprehensive investigations of Prof. Arnold in Sheffield, England, which work was further completed by the publication of Sankey and Smith in 1904. Immediately after these publications, establishing the usefulness of vanadium in steel metallurgy, the most important known deposit of vanadium-bearing mineral was discovered in Peru in 1905, thus ensuring a permanent supply for the establishment of a vanadium industry and a commercial technology for the treatment of vanadium minerals.

WHAT CANADA CAN DO BY DEEPENING THE ST. LAWRENCE-GREAT LAKES WATER ROUTES.

Can construct the greatest waterway in the World.

Can made every Lake Port an Ocean Port.

Can place Western Canada 1,500 miles closer to the markets of Europe and of Eastern Canada and the United States.

Can develop electric energy that will make Canada the workshop of the World.

Can enable Nova Scotia to send coal to Ontario.

Can open up the coalfields of Alberta by providing the Western Provinces with the cheap transportation facilities which are essential to her development.

Can forward the day when Alberta will be the greatest industrial and manufacturing province of Canada.

BRITISH COLUMBIA EXTENDS PERIOD OF PIG IRON BOUNTY.

An amendment has been passed to the Iron Ore Bounties Act of British Columbia extending the period of its operation to 1925. This legislation empowers the Provincial Government to pay a bounty of $3.00 a ton on pig iron manufactured in British Columbia from local ore, and $1.50 per ton on pig iron produced from ore mined outside the Province.

Water Power Development In Canada

The Dominion Water Power Branch, Department of the Interior, and the Dominion Bureau of Statistics, Department of Trade and Commerce have through co-operation, just completed an exhaustive census and analysis of the developed water power in Canada. The figures, which are complete to January 1st, 1920, are exceptionally interesting and are indicative of the marked manner in which the water power resources of the Dominion are being put to advantageous use. Practically every great industrial centre in Canada is now served with hydro-electrical energy and has within easy transmission distance ample reserves of water power. Active construction in hydor-electrical enterprise is fast linking up the few centres which are still unserved, and which have water power resources in their vicinity. In those localities where water power is not available, nature has bountifully supplied fuel reserves of coal, gas or oil.

According to a recent computation the water power resources of the British Empire have been placed at from 50 to 70 million horse power. This does not include such territories, formerly under control of the Central Powers, as will fall in future under British influeice. To this total Canada contributes in the neighborhood of 20 million horse power. This figure represents the power available at sites at which more or less definite information is to hand. Continued investigation will undoubtedly add to this figure.

According to the statistics just compiled there is installed throughout the Dominion some 2,418,000 turbine or water wheel horse power (Table 1), of which 2,215,000 horse power is actually and regularly employed in useful work. The larger figure includes the total installed capacity at full gate, including reserve units. It does not, however, include hydraulic exciter units. A large number of the plants now operating are designed for the addition of further units as the market demands. The ultimate capacity of such plants, together with that of new plants now under construction, total some 3,385,000 horse power.

Of the total power installed, 1,756,791 h.p. or 72.7 per cent is installed in central electric stations. By central electric stations are meant stations which are engaged in the development of electrical energy for sale and distribution. Central station power is sold for lighting mining, electro-chemical and electro-metallurgical industry, milling and general manufacturing. It is apparent therefore that the central station total listed in Column 3 includes a portion of the totals listed in Columns 4 and 5 as used in other industries. In the pulp and paper industry 473,265 h.p. is utilized, of which 381,631 h.p. is generated directly from water in pulp and paper establishments while 91,634 h.p. is purchesd from hydro-central electric stations.

Hydro power used for other purposes and other industries may be listed as follows: For lighting purposes, 434,613 h.p.; in mining industry, 177,728 h.p.; in flour and grist mills, 42,736 h.p.; in lumber and

Turbines and water-wheels installed in water power plants in Canada by number and capacity of units and by provinces. January 1st 1920

	Total water wheels and turbines installed H. P.	Units of 100 H.P. or under		Units over 100 H.P. and under 500 H.P.		Units of 500 H.P. and under 2,000 H.P.		Units of 2,000 H.P. and under 5,000 H.P.		Units of 5,000 H.P. and under 10,000 H.P.		Units of 10,000 H.P. and under 20,000 H.P.		Units of 20,000 H.P. and over	
		NO	H.P.	NO	H.P.	NO	H.P.	NO	H.P.	NO	H.P.	NO	H.P.	NO	H.P.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
YUKON	13,199	6	199	-	—	3	3,000	-	—	2	10,000	-	—	-	—
BRITISH COLUMBIA	308,167	124	4,396	43	10,498	39	44,573	19	62,100	6	42,000	12	144,600	-	—
ALBERTA	32,992	9	492	5	900	-	—	2	8,000	4	23,600	-	—	-	—
SASKATCHEWAN	—	-	—	-	—	-	—	-	—	-	—	-	—	-	—
MANITOBA	83,447	-	—	1	450	2	1,000	9	35,597	8	46,400	-	—	-	—
ONTARIO	1,015,726	734	32,190	182	39,844	147	155,062	77	186,380	14	88,050	36	474,200	2	40,000
QUEBEC	910,029	893	31,942	189	46,626	140	151,461	51	157,825	22	151,075	20	251,100	6	120,000
NEW BRUNSWICK	18,080	61	2,084	16	3,696	10	10,300	1	2,000	-	—	-	—	-	—
NOVA SCOTIA	34,323	324	8,968	38	9,605	19	13,250	1	2,500	-	—	-	—	-	—
PRINCE EDWARD ISLAND	1,933	93	1,933	-	—	-	—	-	—	-	—	-	—	-	—
TOTALS	2,417,896	2244	82,204	474	111,619	360	378,646	160	454,402	56	361,125	68	869,900	8	160,000

TABLE 2

saw mills, 37,918 h.p.; in other manufacturing industries 172,955 h.p. These figures are evidence of the widespread manner in which the Dominion's' water power resources are being applied to the furtherance of its industrial development. In further reference to the foregoing total of water power developed in Canada, it might be noted that during the fiscal year ending March 31st, 1919, there were exported from plants included in tabulation, 175,000 h.p. years.

Table 2 analysing the number and capacity of the water wheels and turbines installed, is of considerable interest. The total installation of 2,417,896 h.p. is comprised of 3,370 units of an average capacity of 715 h.p. While 2,244 of these units are of 100 h.p. or under, they contribute only 82,204 h.p. or 3.4 per cent of the total. A total of 1,845,427, or 76.3 per cent of the whole is contributed by units of 2,000 h.p. and over; 1,391,025 h.p., or 57.6 per cent by units of 5,000 h.p. and over; 1,029,900 h.p., or 42.6 per cent by units of 10,000 h.p. and over; and 160,000 h.p., or 6.6 per cent by units of 20,000 h.p. and over. This table is illustrative of the modern tenedncy towards the installation of large units. Reference might be made in this connection to the 50,000 h.p. turbines which are contemplated for the new development of the Hydro-Electric Power Commission at Queenston.

The statistics in Table 3 refer to the developed water power used in connection with the central electric station industry. The central station industry has made great strides in Canada in recent years. A network of transmission systems, which are being rapidly extended from year to year, covers central and southwestern Ontario and southern Quebec. Other systems established in numerous centres from coast to coast are likewise rapidly extending their scope. Ninety-one point four per cent of the primary power used in the central stations throughout the Dominion is derived from water, evidencing in a striking manner the advantageous location of the water power resources to industrial centres.

The total installed water wheel and turbine horse power in hydro central electric stations is 1,756,791 h.p. Fuel auxiliaries installed as stand-by's to these hydro stations brings the total installed primary capacity up to 1,873,989 h.p., connected to 1,449,180 k.v.a. dynamo capacity. The total capital invested in these central stations, inclusive of transmission and distribution systems is $369,464,961, or an average of $210 per installed primary horse power.

Of special interest to engineers is the actual cost of construction of hydro-electric power stations, exclusive of transmission and distribution systems. The figures of 70 representative hydro-electric stations throughout the Dominion with an aggregate turbine installation of 745,797 horse power show a total construction cost of $50,740,468 (pre-war figures) or an average of $69.11 per installed horse power. This cost includes the capital invested in construction of dams, flumes, penstocks, and all hydraulic works, and of power stations and equipment. It excludes real estate and transmission and distribution equipment. The figure in brief represents the capital cost of construction at the power site.

With a water power development of 274 h.p. per

DISTRIBUTION OF DEVELOPED WATER POWER IN CANADA BY PROVINCES AND BY USE OF POWER. Jan 1st 1920

	DEVELOPED WATER POWER							UNDEVELOPED WATER POWER
	Total Waterwheel and Turbine Horse Power Installed	Total Waterwheel and Turbine H.P. installed for use in			Total Horse-Power actually employed	Ultimate Designed Capacity of Plants now operating or under construction in H.P.	Installed H.P. per 1,000 Population	
		Central Electric Stations	Pulp and Paper Industry	other Manufacturing Industries				
1	2	3	4	5	6	7	8	9
YUKON	13,199	10,000	—	—	11,349	13,199	1,467	100,000
BRITISH COLUMBIA	308,167	211,043	46,962	46,094	276,795	350,832	429	3,000,000
ALBERTA	32.992	32,580	—	17	31,754	33,070	56	466,000
SASKATCHEWAN	—	—	—	—	—	—	—	567,000
MANITOBA	83,447	71,790	—	—	75,100	297,047	135	3,218,000
ONTARIO	1,015.726	794,621	158,095	99.230	934,015	1,460,920	360	5,800,000
QUEBEC	910,029	623,088	249,332	270,961	838,071	1,146,465	391	6,000,000
NEW BRUNSWICK	18,080	9,378	2,693	6,009	16,657	29,115	49	300,000
NOVA SCOTIA	34,323	4,064	16,183	12,276	29,359	52,202	66	100,000
PRINCE EDWARD ISLAND	1,933	227	—	1,789	1,621	1,953	21	3.000
TOTALS	2,417.896	1,756,791	473,265	436,376	2,214,721	3.384,808	274	19,554,000

NOTE:

The central station power listed in Col. 3 is developed for sale. Part is sold to Pulp and Paper and other industies, and such part is included in Cols. 4 and 5 along with the power that is directly installed in these industries.

There were exported from plants included in the tabulation, 175,000 horse power years in the year ending March 31st 1919

TABLE 1

thousand population, Canada stands well in the forefront in respect to availability and utilization of hydro power resources, being only surpassed in this respect by Norway. The enormous water power reserves still untouched form a substantial basis for the progressive exploitation and development of other natural resources, and, if properly co-ordinated with the development and utilization of the enormous fuel resources of the Dominion, are an assurance of continued industrial expansion and prosperity.

Central electric stations operated by Water power.—Primary horse power and dynamo capacity installed and capital invested in stations and transmission and distribution systems Jan. 1, 1920.

	Installed Horse Power in.			Total Installed Dynamo Capacity in K. V. A.	Capital Invested.	
	Waterwheels and Turbines	Fuel Auxiliaries	Total		Total	per HorsePower.
1	2	3	4	5	6	7
YUKON	10,000	—	10,000	6,000	3,471,678	347
BRITISH COLUMBIA	211,043	26,780	237,823	154,571	38,450131	182
ALBERTA	32,580	2,405	34.985	24,260	6,990.972	214
SASKATCHEWAN	—	—	—	—	—	—
MANITOBA	71,790	19,400	91,190	62,313	14,340,458	200
ONTARIO	794,621	39,530	834,151	670,053	170,112,988	215
QUEBEC	623,088	28,163	651,251	522,461	133,645,655	214
NEW BRUNSWICK	9,378	500	9,878	6,160	1,543,727	165
NOVA SCOTIA	4,064	420	4484	3,016	842,122	207
PRINCE EDWARD I.	227	—	227	346	67,230	296
TOTALS.	1,756,791	117,198	1,873,989	1,449,180	369,464,961	210

TABLE 3

Power Developments In Scandinavia

By J. W. BECKMAN.*

A Paper read at the Meeting of the American Electrochemical Society, Boston, April 10th, 1920.

Due to various circumstances, such as wise or unwise legislation, and due to the mental lethargy of the American people, encouraged to a great extent by the availability of cheap sources of energy other than water power, hydro-electric developments have been to a great extent, overlooked and neglected in this country, compared with similar power sources in other parts of the world, in countries often less favorably situated as to coal supplies, but perhaps more fortunate in regard to the selection of their legislating representatives.

It is often stimulating to see what other people have done along a special line, and it is just as often encouraging to see how seemingly insurmountable troubles have been overcome when there was an intelligent public behind an undertaking. The two Scandinavian countries, Sweden and Norway, have been pioneers along hydro-electric developments, and it would seem of interest to get an insight into developments there.

It has become a habit with us in the United States to look to Sweden and Norway, and especially to the latter, as countries favored by a kind Providence as to water power available for development, and it has also become a maxim to consider that power in Norway can be obtained at fabulously low figures due to the extremely cheap cost of installation. Recent information published in a Norwegian technical journal, compiled by Mr. T. Christensen, indicates a decided discrepancy in our assumptions.

We, in the United States, compared with Norway, are very backward in the development of our hydroelectric possibilities. In our country we have unutilized

*Metallurgical Engineer, San Francisco, Cal.

possibilities whch are surrounded by opportunities for the utilization of the power such as Norway never has had and knowing the topography of that country, it is doubtful if they will ever have opportunities as we have them here today. There is no reason to deny the fact that Norway has had some extremely cheap power installations, but in many cases, and perhaps in all of them, the consumers that wanted the cheap power had to move into a desolate wilderness or to an isolated point on the coast line and there install the power-consuming industry.

It might be considered that the power could be transmitted from the generating station to a suitable point for consumption, but in many cases the formation of the country prohibits such transmission lines. Snow-capped mountains, glaciers and climatic conditions form barriers which often eliminate the possibility of long-distance transmission. These are some of the factors which determine the building of hydro-electric plants for industrial purposes, and without knowing all the details connected with the Norwegian developments it is impossible to fully comprehend their locations. It can be said, with a reasonable amount of correctness, that the larger, readily available, cheap power developments have all been taken up and are being utilized for industrial purposes electro-chemical, electro-metallurgical, as well as in the manufacture of wood products.

The estimated average cost to install hydro-electric power in Norway today is 700 Norwegian crowns, or in dollars with normal exchange, when $1.000 equals 3.75 crowns, this would make the cost of installation $194 per installed kilowatt. The investing public of Norway seems to be satisfied with a lower rate of return than that of the United States, since this power is obtainable at the bus-bars at $19.41 per kilowatt year, and this price supposedly covers all costs such as depreciation and amortization of the plant, as well as operating expenses. The transmission cost is apparently large, since the average price of power at the end of a transmission line is $29.33 per kilowatt year, while the charge of power to the small consumer through a distributing system is $53.33 per kilowatt year. Even these figures are low compared with prices charged under similar conditions in the United States. None of the transmission lines in Norway are of any unusual length.

The water-power developments in Norway show a most interesting history and indicate what a financially poor country with a small population can do if it is fully brought to realize the advantages Nature has placed in its grasp. Here it is worth mentioning that the industrial development of all kinds in the Scandinavian countries are due, to a great extent, to the foresight and vision of the daily papers, which are keen and eager to give to their readers authentic articles on technical and scientific matters—the only way by which a true public interest can be created for the intelligent industrial development of the country.

The first use of Norwegian water power was for the purpose of operating grist mills, flour mills and saw mills. The annual development of water power for such purposes has gone slowly forward at the rate of about 1,500 H.P. per annum.

In 1895 only 700 to 800 H.P. electric energy was generated by water; this was the birth of hydro-electric developments.

During the following five years the total increase of water power developed for the production of electric energy amounted to 15,000 H.P., or an average increase of 3,000 H.P. per year. During the following five-year period 40,000 H.P. of water-generated electric energy was installed and there was an average annual increase of 8,000 H.P. 160,000 H.P. additional electric energy was placed in operation during the five-year period from 1905 to 1910, averaging an annual increase of over 30,000 H.P.

It is of especial interest that simultaneously with the increased demand for water power for the purpose of generating electric energy, the water had also been utilized in ever-increasing amounts in the paper industry and in 1910 the two interests, the electrical industry and the paper industry, were consuming about the same amounts: 214,000 H.P. by the paper industry, and 213,000 H.P. for the generation of electric energy.

At that time one-third of the electrical energy generated was used for domestic purposes and two-thirds was absorbed by industrial demands.

During the following eight years Norway made enormous strides in the electrochemical industries, and, consequently the growth of the power-generating industries has been stupendous. In 1910, 15,000 H.P. was consumed in electrochemical industries; in 1918, 770,000 H.P. The domestic demand for power has not grown at all in proportion with that of the industries, and is today represented by a very small percentage of the total.

Sweden is a strip of land approximately the same size as the Pacific Coast States of the United States. dotted all through its length with various industries which have developed their own source of power as one of the inherent parts of their industrial activity, considering the power from the same viewpoint which prompts the development and operation of their own sources of iron ore and charcoal for the iron industries. The power is as much a raw material as any of the other components which make the industry possible, and the cheapest source for power is therefore sought and put into use.

In many parts of the United States an industrial development suffers because enormous power corporations dominate the electric field with a network of transmission lines, covering the country. These corporations, with their generating facilities, are enormous assets to the country as a whole, but due to many circumstances they are forced to charge exhorbitant prices, exhorbitant when considering the power as a raw material essential to an industry.

It is, of course, to the power corporations' interest to see as few of the small power opportunities developed as possible, and to-day, owing to the activities of these corporations a new industry contemplating starting operation asks first this question, in this connection: "Where is the nearest power line?" while in Sweden and Norway under the same conditions the question is, "Where is the nearest source of power that can be developed?"

The result of this attitude in Sweden is indicated by the following official table of 1913, showing use or developments and number of developments in Sweden. and in a marked way shows the position of the small developments. These statistics are undoubtedly much improved since that time, both as to small and large developments. Some very large installations made by the government have since been placed in operation. and these, together with small ones, have increased the total water power developments in Sweden, since 1913, over 30 per cent.

Size of Equipment in Turbine H.P.	Number of Plants.	Total Number of Turbine H.P.
50,000 or more	1	80,000
25,000—50,000	2	68,000
10,000—25,000	6	109,000
5,000—10,000	18	116,000
1,000— 5,000	126	245,000
200— 1,000	296	132,000
		750,000

The following table indicates the uses the power was put to in 1913:

Utilization of the Water Powers for Different Purposes.

	Number of Turbine H.P.	Percentage.
Iron industry.	215,000	29
Paper and pulp industries. .	240,000	32
Textile industry	40,000	5
Electrochemical industry . . .	90,000	12
Power distribution and miscellaneous	165,000	22

Very radical changes have taken place since then in the Swedish iron industry as well as in the electrochemical field. Electric pig iron manufacture has grown rapidly, and 70,000 H.P. is used in these furnaces alone, while in 1913 there were only a comparatively few thousand horsepower used in this industry. The consumption of electric energy for electrochemical manufacture in Sweden in 1917 was 126,000 H.P., and it has grown considerably since then.

It may be interesting to compare the water power reserves of the Scandinavian countries—the two European countries that are most righly endowed—with those of the United States of America. Norway has an estimated potential water power of 7.5 million horsepower, or 3,020 horsepower per 1,000 inhabitants. Sweden has an estimated potential water power of 6.2 million horsepower, or 1,050 horsepower per 1,000 inhabitants. The United States has, according to the latest estimates, a maximum of 67 million horsepower and a minimum of 37 million horsepower, or roughly, 540 and 290 horsepower respectively per 1,000 inhabitants.

As to developed water power, comparative figures are still more interesting. Norway has a population of 2.5 million people and the total developed power for all purposes is 1.25 million horse-power, or 0.5 horsepower developed for each inhabitant. In Sweden there is a population of about 5.5 million people with the total developed power of 1.1 million horsepower or 0.2 horsepower developed for each inhabitant.

In the Pacific Coast States, Washington, Oregon and California, there are 941,000 horsepower developed for all purposes, and in these States there is a population of approximately 5 million people, or 0.188 horsepower developed for each inhabitant. If hydroelectric power were developed at the same rate on the Pacific Coast as in Norway, 2.5 million horsepower would be developed, which would mean that close to one quarter of all available power was at work. Similar figures for the United States as a whole are of no real interest, since topographic conditions in the countries are so completely different.

Comparisons may be odious but they may also be of a stimulating nature. These comparisons indicate how power developments have been pushed in the Scandinavian countries, showing how the power before being developed might have been considered a luxury, and, on being developed, became a national necessity and a national asset of the highest value.

The Scandinavian countries suffer in a marked degree from shortage of fuels. Wood is practically the only native source of fuel, and as an energy source it is practically prohibited. On this account, water power developments are there of primary importance, more so than in a country where there are abundant available sources of suitable fuels for the generation of energy, as in the United States of America where coal and oil have been plentiful. But, in America, as in all other parts of the world, the true conservation is that which is applied in the Scandinavian countries, making the "White Coal" work, by the fullest development of all water power sources both large and small. Each one has it own field, and each development is as legitimate and essential as the other.

DETERMINATION OF RESISTANCE OF METALS AND ALLOYS TO WEAR.

Holz & Co., of New York, issue a brochure on a laboratory device designed to assist in the determination of the resistance of metals and alloys to abrasion, or "wear."

The following extract contains rather interesting data regarding the connection between the relative hardness of metals and their resistance to wear:

In selecting suitable alloys and determining their most effective heat treatment to resist abrasion or "wear" it has often been assumed that the harder the material, as examined by the customary hardness tests, the greater should be its resistance to such forces. However, it has recently been definitely established that there is no relation between the property we call "hardness" of metal and its wear resisting qualities (see test results given below.)

Of late it has become customary to apply hardness tests (by measuring the resistance of the metal to penetration of a ball under static load or to penetration of a cone under dynamic force) to many cases where the hardness as such of the metal is really not involved, but only such properties as its structural strength, ductility, cutting efficiency, or its resistance to abrasion under dry rolling or lubricated sliding friction. The term "hardness" has a definite meaning to the lay mind, but to the expert metallurgist and engineer its meaning is extremely indefinite. Identical forms of so-called harness tests are applied for investigating the best chemical composition, or treatment, of steels called upon for unlike service, as for instance in ball bearings, railroad rails, gears, shovel blades, etc. In a ball bearing, with steel balls running in a race, conditions are demanded which include a minimum of friction under a maximum load, while rails demand the maximum of those properties which give the longest life with the capacity for developing the highest tangential force. There is no relation whatever, for instance, between the cutting efficiency of a tool in a lathe and its hardness as determined by any of the well-known methods. While it would appear that the "toughness" of steel as determined by the impact test, would go hand in hand with its resistance to abrasion, it has been found that those materials which possess a high resistance to wear have, as a rule, extremely low resistances in the notched-

bar impact tests. Scientifically speaking, in steels that have undergone thermal or mechanical treatment there cannot be any relation between such mechanical tests of different nature, as the results of most of them depend upon entirely different structural details of the steel, such as the actual crystal boundaries or the crystalline material of the grains.

Felix Robin (Report on the Wear of Steels; Carnegie Scholarship Memoirs, British Iron and Steel Institute) found, that carbon steels do not wear in inverse proportion to their percentage of carbon. They show a minimum of resistance to wear at about 0.4 per cent of carbon. Pure and fine-grained metal offers most resistance. Phosphorus greatly increases the resistance to wear. Small quantities of manganese and silicon diminish the resistance to dry abrasive wear in the case of carbon steels, which is the opposite to what is found in regard to lubricated wear on a polished surface. Quenched and annealed steels (martensite, osmondite, and sorbite) possess a very high degree of resistance to wear in the vicinity of the eutectoid. This resistance does not increase with higher percentages of carbon. Austenite presents a special degree of resistance to wear, while it is relatively soft under ball impression. The special austenite steels particularly reveal this property. Steels containing nickel and manganese in high percentages are exceedingly resistant to abrasion. Pearlitic chromium steels similarly wear but little, particularly in the case of annealed steels. Vanadium considerably improves the resistance of steels to wear under abrasion.

The following table is a summary of Robin's tests of Brinell hardness and wear (loss in mgr. per sq. cm. of abraded surface; thus the largest wear shows the highest number) on a number of steels:

Brinell Hardness.	Wear.	Brinell Hardness.	Wear.
95	160	250	47
149	55	255	202
155	170	355	27
180	58	453	105
190	204	574	27
		600	53

These figures show that there is absolutely no relation between "hardness" and "resistance to wear" on steels of similar or different composition or treatment.

AMERICAN STEEL TREATERS SOCIETY FORMS TORONTO BRANCH.

A Toronto Branch of the American Steel Treaters Society was formed on the 20th April, and held its first gathering at the King Edward Hotel, where an address was given by Mr. W. H. Eisenmann of Chicago on "Heat Treatment, Its Past, Present and Future." Our readers will recollect that a note on ancient beliefs and practices in relation to steel, by Mr. Paul Kreuzpointer of the Society was published in the December issue of this journal. The Toronto Branch will hold monthly meetings.

Plate Mill Dominion Steel Corp.

EDITORIAL

Tendencies of Works Operation

The existing editorial direction of "Iron and Steel of Canada" was assumed a year ago, and at that time we endeavored to deduce the tendencies of the iron and steel industry from the viewpoint of the operating officials. Among the tendencies that were considered to define themselves the following were mentioned, namely, a continuance of high prices for commodities, accompanied by high wages, shortened working hours and decreased efficiency. It was suggested that the tendency to shorter hours of labor would have to be overcome by multiplying the turns in the twenty-four hours, and the investment of money in labor-saving devices was urged.

It was also suggested that only by a policy of increased coal production, and its augmentation to a point "where the coal supplied to steel works is only a relatively small part of the coal raised and sold" would it be found possible to produce coal at the minimum of cost, and at such a figure as would permit competition of domestic steel products in the markets of the world.

The opinion was also expressed that, apart from the local influences modifying Canadian business, we reflect in this country, later in time, the business conditions prevailing in the United States. We believe that at no previous time in Canadian business was the dominating effect of conditions in the United States so marked as at this time, and business conditions in Canada are now so modified by occurrences to the south as to make it very difficult to obtain a correct domestic perspective.

Successive strikes in the steel industry, at the coal mines and on the railways of the United States have upset all the ordinary courses of supply and demand, and Canadian iron furnaces and steel mills have been affected according to their state of dependence on United States sources of raw materials.

The steel strike in the States has created an insistent demand upon Canadian mills that ordinarily compete with United States producers, and at the same time it has badly disorganized those secondary industries in Canada that depend upon the United States for primary products.

The coal shortage is seriously curtailing all branches of the iron trades in Ontario, particularly the important group of enterprises situated in and around Hamilton, and it is a matter for very grave concern to know that there is small likelihood of the coal shortage in Ontario being relieved from the usual United States sources.

In the East, the sitaution is likewise dominated by coal supply. The outputs are running from 30 to 40 per cent below pre-war figures, and a large foreign export trade is being carried on in coal, with the result that steel-making is being limited by an insufficient coal supply.

The iron and coal trades in Canada therefore are in a position of much uncertainty. We are so entirely at the mercy of events in the United States, and so unable to control those events in the slightest degree as to suggest that those who have the management of Canadian steel enterprises must make careful study of tendencies below the line, if they are to anticipate events at home.

The outlook in the United States is not a quiet one. Apart from the usual accompaniments of a presidential election year, the prospects are for higher coal prices, higher freight rates, and there is the gravest possibility of labour troubles in connection with the steel industry and the railways later in the summer.

Such a combination of conditions will make for erratic variations in demand for steel products in Canada, and quick changes in selling prices. It will mean that some Canadian plants will do extremely profitable business, and that others will be hampered by shortage of materials, or, in brief, a continuation of eixsting conditions, but more pronounced.

As to commodity prices, a survey of the wheat yields and coal production of the world, as recently recorded and in prospect, indicate, fairly convincingly, that no increase in production or decrease in price is probable in these two basic necessities, which decide the price and availability of all other commodities.

It is unlikely, therefore, that any reduction in wages can take place, or will take place until the wastage of war has been overcome, and until world production approaches a point that will occasion unemployment.

The works manager at this time should seek in his plant the utmost adaptability, the utmost economy of manual labor and maximum use of mechanical substi-

tutes, and in himself a more complaisant attitude towards new methods than has hitherto been considered orthodox. If adaptation to environment is the secret of persistence of species, as was once taught, then the works manager requires to be a quick-change artiste. Restfulness has not been a characteristic of the steel man in recent years, but the future offers slight prospect of ease or stagnation to the energetic executive. Especially must he keep himself abreast of world news, and tendencies in the United States.

CONSOLIDATION OF STEEL AND COAL COMPANIES A MEASURE OF NECESSITY.

During the Budget debate, the Hon. Mr. T. A. Crerar is reported to have quoted Col. Grant Morden as stating that British Steel Corporation, if and when completed, would be able to compete with the world. "Why not then," asks Mr. Crerar, "remove the duty on coal and steel?"

We do not believe that Col. Morden ever expressed himself to this effect, and if he did, he made an inaccurate statement. What we beliecve Col. Morden desired to convey was that only by a consolidation of the coal and steel interests of Nova Scotia could these hope to enter the markets of the world. On a fair and square basis of competition, without regard to the desirability of possessing operating collieries and active steel works in Canada, the coal mines of Eastern Canada, and those industries which are based upon coal, namely, the manufacture of coke, the recovery of the chemical products of coal distillation, the smelting of iron, the manufacture of steel and finished steel products, and the fabrication of steel ships, none of these can hope to compete successfully against the coal industry and its offshoots in the United States; or against the coal industry of Great Britain, Belgium, Germany, Russia, and China and its offshoots, under normal peace conditions.

The acceptance of Col. Grant Morden's proposals to consolidate their interests by the directors and shareholders of the coal and steel companies in Nova Scotia will not be evidence of a desire to water the stock, but it will be evidence of a realization that these various companies cannot anticipate successful survival under independent management. As we stated in the last issue of this monthly, "the formation of British Empire Steel Corporation is above everything a measure of necessity and self-defence. Its first duty will be to consolidate its position, to conserve its resources, and these tasks, rather than dreams of aggression, will occupy all the energies of those who are chosen to manage the Corporation for many years to come."

Mr. Crerar proceeded to express his inability to support a fiscal policy that develops mergers such as British Empire Steel, "which is practically cornering all the coal and iron ore in sight in the Maritime Provinces." It would not, by the way, be a great task to corner all the iron-ores in the Maritime Provinces. The commercial occurrences are negligible, so far as known. They are probably not all known, however. "I would suggest to the Minister of Finance," continued Mr. Crerar, "that one of the most effective ways in which he can combat this growing tendency to combine various companies into huge combinations is by using the weapon of the tariff." Apparently Mr. Crerar considers combination to be wrong, in itself. In this regard Mr. Crerar is not consistent. Combination for the grain - grower was brought about by precisely the same economic laws that have suggested the steel merger, and we see little intrinsic difference between the high fixed price of wheat and the protection given to coal and steel by the tariff. The coming together of the coal and steel companies in Nova Scotia has been occasioned by a much more potent weapon than the tariff. Independent and competitive operation of the coal trade in Nova Scotia has been tried for sixty years, and has proved to be a conclusive and dismal failure.

The cost of mining coal in Nova Scotia is relatively high, and the physical difficulties adding to the cost of mining are increasing and must continue to increase. The supply of labor is relatively scarce, and a review of the past record of the dispersal of emigrants to Canada would indicate that it is likely to continue so. Moreover, Nova Scotia has only 400,000 inhabitants, and whether it can be remedied or not, it is a fact that the newly arrived immigrant only rarely goes to Nova Scotia, and, after residence in Nova Scotia, shows a desire to go westwards. These are some of the permanent drawbacks to mining coal on a large scale at relatively cheap cost in Nova Scotia, and explain why it is considered necessary to get together for mutual self-help and protection.

The main feature of Col. Morden's proposals as they appeal to the coal and steel companies, is the undertaking to raise $25,000,000 of new capital from outside sources. This is not a large sum in consideration of the requirements. Much more than $25,000,000 of new capital expenditure is required to place the coal and steel production of Nova Scotia on a basis that will make it a respectable factor in the world's markets. Some sense of proportion is required in viewing these matters. The statement has been made that five billion tons of coal are at the disposal of the proposed constituent companies of a mooted merger. Such a statement does not accurately represent the facts unless it takes into account the position of the coal reserves. It would be much more accurate to state that large capital expenditures, necessitating the obtaining of outside assistance, are necessary to place the coal holdings of the companies at their own disposal.

As to the effect of the protective duty on coal, what does it amount to? There is no duty on anthracite, and a very small duty on bituminous slack coal. The

duty on bituminous coal is 53 cents, and by judicious shipments of slack and screened coal and their subsequent admixture, it can be lessened to an average of 33½ cents. Can it be contended that an impost of this amount inflicts any great hardship on Canadian consumers, or that its complete removal would lower the cost of United States coal to the consumer here? The protective value of the duty has almost disappeared in the rising cost of coal production and transportation. The duty might be taken off United States coal tomorrow, and the Canadian consumer would never know it from study of his coal bill. The chief loser would be the Canadian Treasury, and the most apparent result would be the necessity for new taxes to make up the deficit occasioned by loss of this revenue. And there are a few other reasons, which the Finance Minister could doubtless mention, why it is not desirable to encourage greater importations from the United States at this time. A thirteen per cent discount on the Canadian dollar is one of them.

The coal duty today does not represent any appreciable or adequate measure of protective tariff. It is really an excise duty for the raising of inland revenue.

The value of the coal deposits of Nova Scotia consists in large measure in their being the one Canadian source of coal east of Saskatchewan. They constitute 0.7 per cent of our national coal reserves, but they are the only source of coal supply that Canada owns within a territory that contains 80 per cent of her population. It is their position and strategic value that is remarkable, not their extent. They can only be made fully available as a source of coal supply in Canada by the expenditure of very large sums of money, and any consolidation of interests that carries with it the promise of such expenditure will benefit the country as a whole. If Mr. Crerar were Minister of Finance in Canada we can conceive that he would welcome a business consolidation that promised increase of employment, increase of internal revenue, increase of provincial coal royalties, decreased public taxation, and a decrease in imports accompanied by an increase in exports. All this, and much more, will proceed from the consolidated operations of British Steel Corporation if its organization should be consummated, and if its promoters will recognize from the first the relatively high cost of mining coal in Nova Scotia.

CAPITALIZATION OF BRITISH EMPIRE STEEL CORPORATION COAL AND ORE RESERVES.

A series of three well informed articles on the financial condition of the nine companies which it is proposed to consolidate as British Empire Steel Corporation appears in the Toronto "Globe," and is concluded with the following discriminating comment, viz.:

> "On the question of total assets Col. Morden insits that there has been a conservative valuation of the iron-ore and coal in the ground belonging to the various companies, the value of which is now placed at $203,000,000 of the total assets valuation of $407,000,000. The fact remains that the total assets of the leading companies of the nine in the merger are placed at slightly less than $200,000,000 in their last annual reports. It is manifest that Col. Morden has adopted a different basis of valuation from that of the unit companies in preparing their annual reports. It is to be presumed that the coal and iron ore has hitherto been regarded as a nominal asset, which may explain the difference. This does not, however, relieve the new company from the necessity of most efficient management in seeing to it that the valuation put upon the coal and iron as in the ground is not above what is warranted in consideration of the coal and iron as a marketable commodity —in other words, the plan of organization to this extent capitalizes the future and contemplates many years of successful operation in bringing the raw materials to the Corporation's plants, and making them into millions of tons of marketable articles."

The capitalization of minerals in the ground is a difficult matter, and probably the safest method is to regard them as a nominal asset. This is particularly so where the mineral deposits are so largely submarine, as in the case of the coal and iron-ore areas of the constituent companies of the new Corporation. The greatest asset of the new Corporation will be its complete control of the points of access to the submarine mineral deposits, and the advantages that will accompany unified direction of the technical operations of winning the minerals. Another substantial asset is the land area of unworked coal. With the exception of the winning of the three upper seams in the Sydney Field the land area is virgin coal. The seams crop concentrically each outside of the next superimposed seam, and thus, as the lower seams aer reached, each one contains a larger superficial area of ungotten coal. These lower seams have hitherto been disregarded because of the better quality and great accessibility of the upper seams. Nevertheless, it may be stated that the ungotten land coal will provide the most dependable and lasting asset of the future. Comparative thinness of seams, less desirable quality, and, to an inexcusable extent, lack of accurate knowledge of the lower seams, are hindrances to profitable extraction that will gradually disappear under the compulsion of necessity, improved methods of extraction, and modes of preparation that have long since been matters of ordinary practice in other countries.

In connection with the submarine area, both coal and iron-ore, only a nominal value should be placed

on the estimated content of mineral, because, while the supposition of their extension at least to the limits of profitable extraction is founded on excellent grounds, in the absence of actual knowledge there can be no absolute certainty such as is required in actuarial calculations.

There are also some fixed and unavoidable first charges on coal and iron-ore won from the most accessible and certain situations, which are emphasised in making future calculations on ungotten submarine areas, namely charges for depletion of areas, for redemption of capital, and for the provision of new openings to take the place of abandoned winnings. It will be an essential to the permanency and success of the new Corporation (which we desire again to emphasise, believing that exaggeration of emphasis on this point is impossible, is founded on the extraction of coal at a profit) that these charges shall be a primary addition to the other costs of coal production.

We note that the nominal capital of the new Corporation is fixed at $500,000,000, and that while the appraised value of the aggregate assets of the constituent companies is placed at $407,000,000, it is only proposed to issue securities of a par value of $207,000,000, or approximately the sum of the assets of the combining companies as shown by their respective balance-sheets. From this we deduce that it is not the intention of the promoters of the new Corporation to issue share capital to the full extent of the appraised assets. In view of all the factors of uncertainty that surround the profitable winning of coal and iron-ore from submarine areas — some of them very remote from land — it is probable that the technical advisers of British Empire Steel Corporation will counsel the inclusion of the ungotten coal and iron-ore tonnages in the balance-sheet of the Corporation at purely nominal figures. It is also to be expected that the cost-sheets of the mining companies will be complete cost-sheets, showing the ultimate cost of coal over the whole expected life of the deposit under consideration, and not partial, and therefore inaccurate, cost-sheets such as have too often in the past led to erroneous conclusions and consequent financial embarrassment.

THE IMPRESSIVENESS OF STEEL SHIPBUILDING IN CANADA.

The present Canadian Government never did a better thing than when it undertook the formation of a merchant shipping fleet. Commenced as a measure of necessity following the wholesale sinking of merchant ships during the war, it has now been recognized as a proper policy under any circumstances.

A previous Government, a good many years ago, forced Canadian registration upon vessels employed in Canadian coastal waters, but did not logically supplement that action by encouraging the building of ships in Canada. The necessity to do this was clearly pointed out at the time, but there was a general impression abroad that Canada could not compete with British yards in price. This was admitted, but what has not been shown is the necessity to compete. When a country wishes to commence a new industry it must pay the price. Shipbuilding subsidies are not new in our history, and have proved to be a necessary form of national encouragement of marine trade. Great Britain's supremacy among the world's marine carriers was initiated by liberal government subsidies. The competition which British shipping lines met from United States shipowners lessened, and became a factor of little importance when the United States withdrew its assistance by subsidies. A reference to an address given before the Canadian Mining Institute in March, 1918, by Col. Thos. Cantley (published in the second issue of this periodical) will show that substantial subsidies have been granted to encourage marine trade by every notable nation in the world, and their world status, at the outbreak of war, was proportionate to the expenditure on shipping subsidies.

There is no blinking the impressiveness of steel shipbuilding in Canada at this time. One of the most encouraging signs is the courage of shipbuilders to lay down keels in expectation of selling the completed vessel, or operating it in case a sale is not made. So far, those who have taken this course have been justified in it.

During the past few years we have seen grow bit by bit in Canada the number of persons skilled in the art of building steel ships. This is an entirely new asset of Canada. Canadian workmen had to acquire this knowledge, and with every steel ship that has been launched there has been added to our national wealth, not only the value of a new vessel, but what is of much greater value, namely the ability to construct other vessels, each one creating master workmen.

There is no industry that opens up more avenues of profitable occupation than steel-shipbuilding. Before a steel ship can be made, coal must be mined and iron wrought. After it is launched and fitted out for sea it becomes at once a cause of export trade, and in its operation a source of employment and of continuous revenue. A country founded by men from Glasgow, Devon and Breton, that has coast lines on the two great seas of commerce, and can be, if it desires, a maritime country for 1,800 miles inland, does not need to be told the things that accompany a merchant marine. The capacity for sea trade and traffic is in our blood. Every Canadian has in him the spirit of the ancestor who crossed the seas to find a home here. For these reasons the present impressive extent of our shipbuilding industry is a source of national congratulation and pride.

We believe, from the past record of the present Government, that it will go very far to make the building of steel ships, and their fitting-out, a permanent growing feature of Canadian industry.

WORKMEN'S COMPENSATION IN NOVA SCOTIA

In this issue is published a digest of the Report of the Workmen's Compensation Board of Nova Scotia for 1919. Of especial interest is the gratifying reduction in the number of fatal accidents, and the lowering of the assessment rates in the coal-mining and iron and steel trades. In commenting in these columns on the 1918 Report we suggested that it should be possible eventually to fix the coal-mining assessment at 2.5 per cent of the payroll. The rate was fixed for 1919 at 3 per cent, but the year's operations show a surplus in this class of $127,640. The rates for the iron and steel trades is placed at 1.5 per cent, and in this instance the surplus of approximately $30,000 indicates that it is probably a permanent rate. We do not believe that the hazard in coal-mining is twice that in the iron and steel trades, and with the respectable disaster reserve now accumulated, a further reduction in the rate of coal-mining assessment may be anticipated. Coal mining is not so distinctly a hazardous occupation, as it is an occupation in which a large number of simultaneous deaths may occur for well-known reasons.

WORKMEN'S COMPENSATION IN NOVA SCOTIA DURING 1919.

The Report of the Workmen's Compensation Board for 1919 in Nova Scotia records a gratifying decrease in the number of fatal accidents. The figures were abnormally high in 1917 and 1918 because of the incidence of two disastrous coal-mine explosions and a lumber camp fire in those years, but after allowing for these occurrences, the record is still very encouraging, as will be seen from the comparison following:

	1917.	1918.	1919.
Fatal Accidents	146	185	47
Deduct Disasters	65	105	..
	81	80	47

"A further analysis," states the Report, "discloses "that the greatest improvement must be credited to "the coal mining industry, in which not only were "disasters avoided but the ordinary fatal accidents "were reduced to exactly half what they were in "1918, as shown by the following statement:—

	1917.	1918.	1919.
Total Fatal Accidents	97	126	19
Deduct Disasters	65	88	--
	32	38	19"

The total number of compensable accidents has varied very litle, being 4,888 in 1919, comparing with 4,836 in 1917 and 4,931 in 1918.

Assessment rates were lowered from those of 1918 as follows:

	Assesment Rates 1918.	1919.
Coal Mining	4..	3.0
Steel and Iron Mfg.	1.9	1.5
Building	2.0	1.5
Stevedoring	4.0	3.0
Steam Railways	4.5	2.0
Lumbering, etc.	3.0	2.5

The lowering of rates is stated to have been justified, and to have resulted in substantial surpluses during 1919, except in the case of lumbering and sawmill industries, which shows a deficit. The divisions of mining, iron and steel manufacture, and railways showed quite large surpluses.

The ratio of administration expenses to the total assessment has shown a steady increase, being 5.76 in 1919, compared with 3.66 in 1918 and 2.58 in 1917, the first year of operation. This understandable, as the work of the Compensation Board will be for a certain period a cumulative condition.

The investments of the Board at the end of 1919 totalled $2,233,026, compared with $1,579,031 at the end of 1918. The whole is invested in Nova Scotia provincial bonds and Dominion Government bonds, the last-named to the extent of $1,990,000.

The Report mentions the formation of an Accident Prevention Association, previously noted in these columns.

The accounts of the Board has been audited by the Provincial Auditor.

A significant statement is that out of 4,504 cases of temporary disability during 1918 there developed sepsis in 104 cases. In 1917, by a coincidence the number of similar cases was also 4,504, but only 74 cases of sepsis developed.

The Report contains a number of interesting statistical tables, which, if continued under the same arrangement for a number of years, will permit of valuable deductions.

THIRD ANNUAL MEETING OF THE CANADIAN INSTITUTE OF CHEMISTRY, TORONTO,

The third Annual Meeting of Canadian chemists was held in Toronto on May 27th and 28th, and was well attended by members from all parts of Canada, and by visitors from the United States.

Among the papers read was one by Messrs. Roast and Pascoe, given before the Montreal Branch of the Society of Chemical Industry in February last, on the "Inner Life and Habits of Metals." This paper was fully illustrated by a series of microphotographic slides, prepared by the authors. Mr. Roast is the Secretary-Treasurer of the Canadian Institute of Chemistry, and an ardent worker in the interests of the profession.

Dr. Charles H. Herty, Editor of the "Journal of Industrial and Engineering Chemistry," and a past-President of the American Chemical Society, addressed the meeting on "Chemistry under a Constitutional Government," and pointed out convincingly how great a part the chemist played in the industrial life and in the military defence of a democratic state.

Prof. Matthew A. Parker, of the University of Manitoba, was appointed a delegate to the inter-allied Chemical Congress in Rome during July.

The Toronto Meeting was the first annual meeting of the newly formed Canadian Institute of Chemistry a full description of which, with a list of the original officers was published in our May issue (See page 124.)

The Dominion Engineering Works, Limited, Lachine, Que.

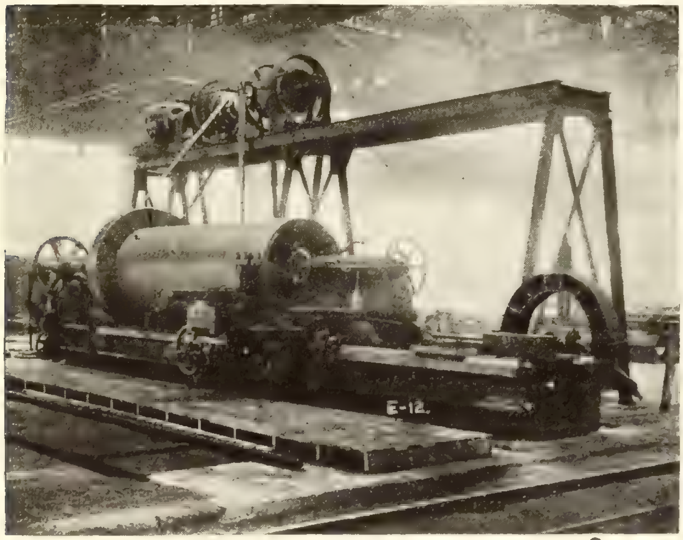
(By the Editor).

The Dominion Engineering Works has been formed to manufacture paper-making machinery and hydraulic machinery on a scale commensurate with the requirements of Canada.

The relatively important pulp-wood resources of Canada are a matter of contemporary notoriety. What is perhaps not so well known is the growth of the paper-making industry in Canada, as distinct from the exportation of pulp-wood and wood-pulp. The manufacture of the numerous and varied products of wood-pulp in the Dominion, of which paper is chief, is of rapidly growing importance, and is a natural result of the desire of Canadians to elaborate the raw materials of the country into finished products at home in preference to exporting the basis of profitable industries and employment. The demand for paper-making machinery is for these reasons likely to be heavy and well maintained in Canada.

with the country, and it has the further advantage of a thoroly competent technical management and a trained staff of workers of unusual ability and experience.

The Company has taken over the erecting and machine shops of the St. Lawrence Bridge Company at Rockfield—about a mile from the Dominion Bridge Works at Lachine—especially constructed in 1912 for the fabrication and assemblage of the members of the Quebec Bridge. These shops are of substantial fire-proof construction, well laid out as to lighting and the transference of heavy parts, having rail connection with both the Canadian Pacific and the Canadian National systems and situated within a short transfer distance of the Lachine Canal. The works are connected with the power ducts of the Montreal Light Heat and Power Co., and possess in addition a stand-by steam plant.



48 inch Dryers being turned on Fifield Lathe

72 inch Dryers for Laurentide Paper-Machine—rough-turned

The available water-powers of Canada are estimated as being approximately 20 million horse-power, of which, as yet, only 2,418,000 horse-power is utilised by water-wheels and turbines.

The great possibilities of the use of hydro-electric power in electro-chemistry and in electro-metallurgy, and in particular the advantages that can be offered to industries using continuous processes in "off-peak" at low rates, have been very fully referred to in recent issues of "Iron and Steel of Canada." The call for hydraulic machinery will be very insistent in Canada for many years to come.

The Dominion Engineering Works is closely connected with the Dominion Bridge Company, a company with a management that has, as we stated in a previous issue, "combined engineering ability and foresight as to the needs of Canada with a keen appraisement of the commercial opportunities." An account of the formation and directorate of the new Company has published in our last issue, and need not be repeated. (See page 129.)

The Dominion Engineering Works is therefore organized to supply an insistent demand that will grow

Shops.

The main building is 660 ft. long and 220 ft. wide There are two erecting bays with spans 85 ft. and 75 ft. each by 220 fe. long. The side bays are 60 ft. wide and 440 ft. long, and contain the boiler house, power house, tool room, blacksmiths' shop, flask making department, timekeeping offices, etc.

The crane equipment is particularly complete. It consists of two 35-ton cranes, running longitudinally, and four 40-ton cranes, with crosswise travel. The longitudinal craneways have a capacity of 75 tons, and a 75 ton crane has been ordered to replace one of those now in position. There are also seven 10-ton assembling hoists.

The erecting bays are equipped with six 6-ton jib cranes with longitudinal travel. One of the erecting floors will be reserved for the assemblage of paper-making machinery, and the other floor will be used for the hydraulic machinery.

Foundry.

The foundry as at present used, is a building 145 ft. by 181 ft. but will shortly be enlarged to 145 ft. by 330 ft. The cupolas comprise one of 84 inch dia., not

yet installed but shortly to replace the 37 inch cupola now in place, and one of 54 inches. There are two casting pits, but the foundry extension will be equipped with a casting pit 120 ft. long by 30 ft. wide and 8 ft. deep, intended for pouring the large castings to be used for the water turbines. The equipment of the foundry further includes a modern sand-blast room, large and small core-ovens, jolt-rammer, etc. A cinder-mill is used for reclaiming metal and coke from the cinders. The foundry is equipped with a 70-ton and a 15-ton crane.

The steam-plant consists of six Robb boilers aggregating 1,000 h.p., a 2,000 c. ft. air-compressor, 400 kw. d.c. generator direct-connected with a Bellis-Morcom engine, and a 500 kw. motor-generator set. The brick stack is 150 ft. high.

The pattern shop is a separate brick and steel building 176 ft. by 60 ft.

The machinery is not yet all in place, but it is intended to provide some very large tools that it will be of sufficient capacity to handle the largest sized machinery parts that are expected to be used in Canada. Similarly the foundry is being equipped to make castings of the largest dimensions that can be transported in the country.

The machinery, already installed and to be provided, includes drills, slotters, boring mills, lathes, planers. key-seater, bolt-threaders, hob-grinders and gear-cutting tools, wheel presses, etc. A Farrell grinder, 32 inch. by 240 inch, is in use for truing up the ironing rolls of paper-making machinery, an operation requiring great precision.

The general equipment of the shops will be of a specialized and thoroughly adequate character.

The machine-tools are grouped around shafting supports erected from the floor, an arrangement that leaves the roof free for the movement of the cranes and hoists, and relives the roof trusses of weight. The machine-tools are grouped according to type to facilitate the work and supervision.

There is ample floor space both for assembling and erecting, and for any additional machinery that may be provided.

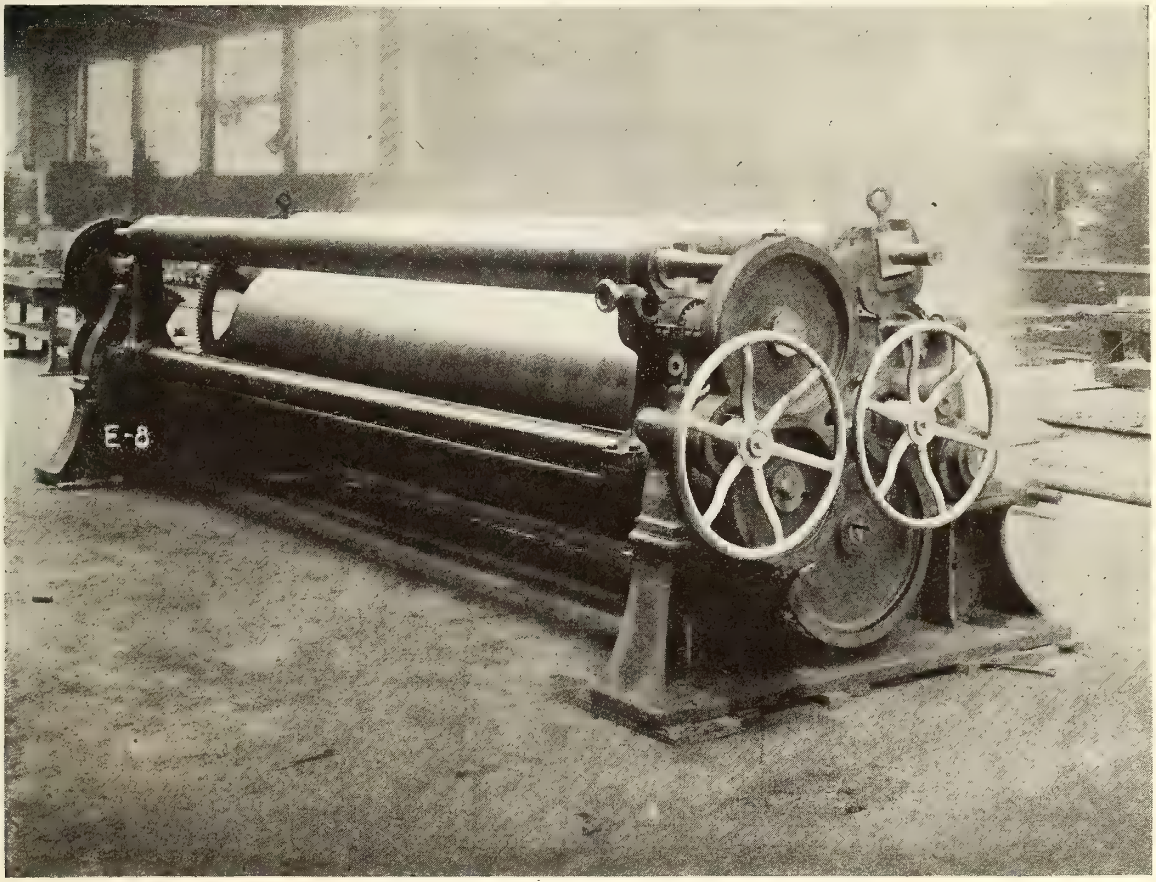
At the present time the works are building two 166 inch high-speed newsprint machines for the Laurentide Company. These machines are of the latest type. The dryers, which weigh 16 tons in finished condition, and are 72 inches in diameter, revolve at a speed of 1,000 ft. per minute, and require very exact balancing. Generally speaking, paper-making machinery is of simple design. It consists essentially of passing a film of wood-pulp over a series of dryers heated with steam, and through a number of rolls covered with rubber, felt, or made of polished metal, as required. This train of drums and rolls revolves very swiftly, and must be fitted with exactness and very small clearances, and, while the separate parts are of intricate design,, they must be made and fitted with precision.

Paper-making machinery already made and delivered by the predecessors of the Dominion Engineering Works (The Dominion Engineering and Machinery Co.) includes one 48 inch fourdrinier writing-paper machine for the Howard Smith Co., Beauharnois, Que.

In addition to the Laurentide order there is also being built a 148 inch Harper tissue-paper machine for the Interlake Tissue Mills.

Hydraulic Machinery.

The Company has obtained the exclusive Canadian



Pope-reel for 166 inch high-speed Newsprint Machine
for Laurentide Paper Company

rights for the manufacture of hydraulic machinery from the designs of the I. P. Morris Co. of Philadelphia whose patented designs and patterns will be available for use. The I. P. Morris Co. is the turbine-division of Wm. Cramp and Sons Ship and Engine Building Co. of Philadelphia. Mr. H. B. Taylor, vice-President of Messrs Cramps is a director of the Dominion Engineering Works, Limited.

At the present time the Company is building two 20,000 h.p. water-wheel units for the Laurentide Co., being a duplicate of the units now in operation at this Company's plant.

The work already done by the Dominion Engineering Works, and that in immediate prospect, together with the large expansion which must necessarily follow an enterprise that opens up so specialized, and at the same time so undeveloped a field as this company has chosen for its activities, forecasts a noteworthy extension of the metal-working trades in Canada.

Dominion Steel Corporation to Erect Sixty Additional Koppers By-Product Coke Ovens

The Koppers Company of Pittsburg has received an order from the Dominion Iron & Steel Company for a third battery of by-product ovens, sixty in number, similar in every respect and to be worked in conjunction with the two batteries recently built by the Koppers Company at Sydney and now in successful operation.

The Editor recently had the opportunity to look over the two batteries put into operation in October 1919 and March 1920 respectively, which were very fully described in "Iron & Steel" of December issue by Mr. C. E. Wallin, the Superintendent. The most striking feature of the plant in operation is that it is not conceived as coke-oven plants once were, namely as a series of separate coking chambers, but it is in every sense a unit, the working of which can be watched and controlled by the superintendent from the office with ease and accuracy.

The 120 ovens are producing 1,100 tons of 18 hour coke every 24 hours, or approximately ten tons of coke per oven per 24 hours. A coke-oven installation of this size of the older types would employ possibly 450 men. The entire working force at the Sydney ovens numbers 160 men, which includes the by-product staff, repairers, etc.

Every operation that it is possible to carry out mechanically is so worked. The successive operations of removing the oven doors, pushing out the coke with the ram, replacing the door and levelling down the newly-charged chamber by means of the mechanical leveller are all performed from one platform by the operator on the pusher and leveller machine, who is kept continually employed, the schedule calling for the pushing of an oven every nine minutes. On the discharge side of the ovens there operates a mechanical door-handler, which is followed by a travelling stage from which the work of luting the newly-charged chamber is quickly performed with a minimum of effort.

Panoramic view of By-Product Plant. Coke-quenching Tower on left.
Dominion Iron & Steel Co., Sydney, N.S.

The cake of red-hot coke falls into the quenching car, and is carried to the quenching tower where it is subjected to a thorough drenching, after which it is dumped sideways on to an apron leading to a conveyor belt, thence to the screening plant and finally loaded into railway cars. The quenching of the coke in the open air, followed by the run to the apron and conveyor belt results in a coke that is free from excess moisture and shows no black ends. Owing to the narrow width of the oven chamber, averaging 17 inches, and the fact that a line of partition forms in the coke cake through the centre and parallel to the sides of the chamber, the length of the individual coke pieces does not exceed 8 inches, but is very uniform at about this length. The coke, as it finally reaches the railway car for transport to the blast-furnace, is evenly sized, strong, free from breeze, of even texture and entirely free from black ends, so far as one could observe.

An interesting departure from traditional usages around by-product coke-plants is the presence of bulletin boards at various parts of the plant giving the analyses of the gases in succeeding stages. There was a time when secrecy in the arts reached its absurdest point in by-product plants, and it may be taken as a general indication of the changed viewpoint of coke-oven engineers who today realize that if an employee is going to give the best of himself and his brains he should be allowed and, indeed, expected to know something about his business.

A bulletin board showed the analysis of the surplus gas on the 4th of May, which it may be of interest to compare with the average analysis of similar gas given in Mr. Wallin's article.

	Average Analysis Per Cent.	Analysis 4th May Per Cent.
Carbon dioxide	2.0	2.2
Illuminants	3.5	3.4

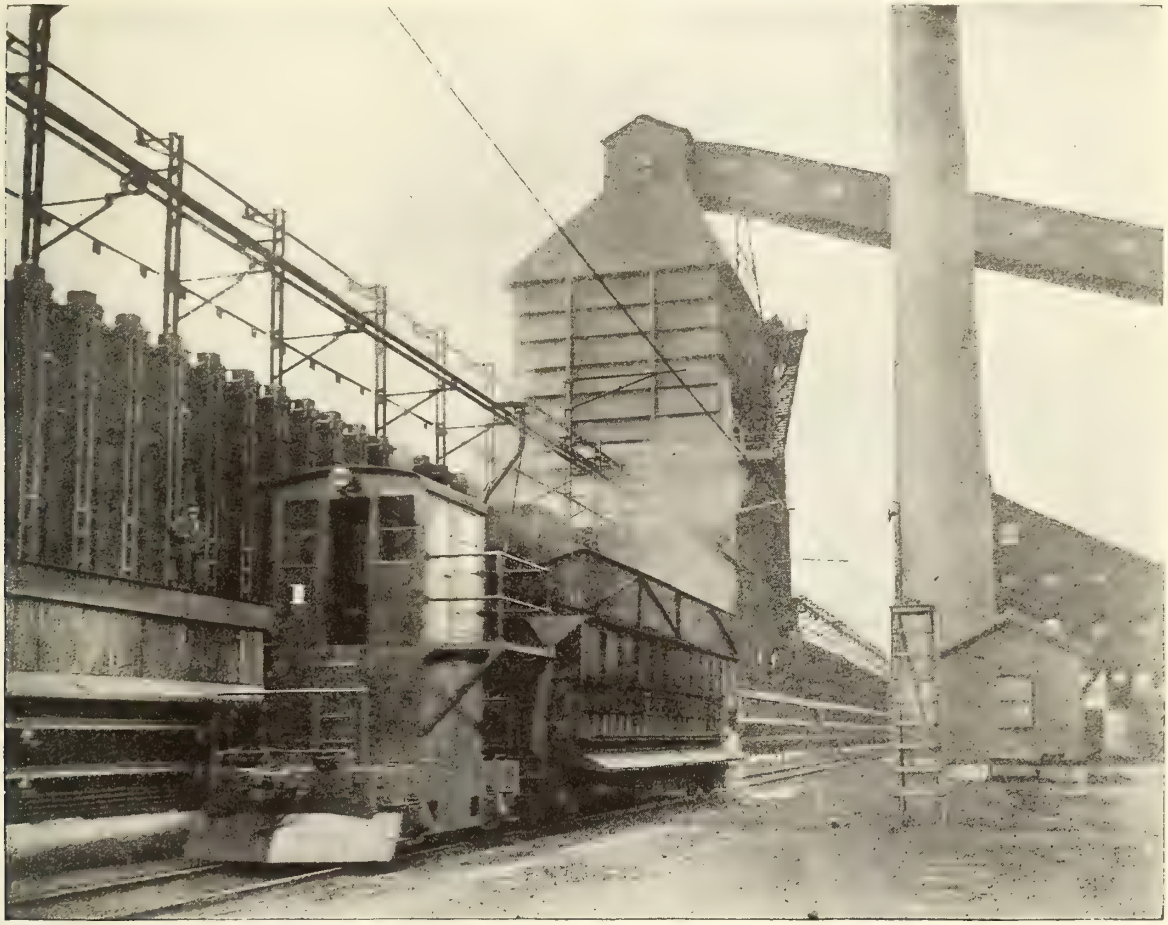
Oxygen	.5	.6
Carbon-monoxide	7.0	7.2
Methane	31.5	30.8
Hydrogen	48.5	48.0
Nitrogen	7.0	7.8
B.T.U.'s per cu. ft.		587

The sulphate of ammonia is of much superior physical grade to that made by older processes. It is of good color, finely crystallized, resembling epsom salts in texture. It has not the tendency to pack in storage that has been a drawback to the product of less modern processes. The sulphate of ammonia seen by the writer would be very easily distributed upon the soil, or mixed with it, a considerable advantage in the use of this valuable, but potent fertilizer.

A look around the coke-oven departmetn of the Dominion Iron & Steel Company affords a microcosm of the history of by-product coke plants. The first ovens built around 1900, were among the first by-product ovens in America. They were of Otto-Hilgenstock type, and about contemporaneous with the similar plant designed by Dr. Schneewind for the Everett Gas Co., near Boston. They long since were abandoned, and are now being utilised for the construction of brick-kilns in connection with the silica-brick plant the Steel Company expects to erect immediately.

Further back from the railway track is the No. 2 Battery of by-product ovens, only recently representing the best type of construction, but now idle and awaiting conversion and repair to bring them more up to date.

It is conceivable that even the latest Koppers ovens, which without exaggeration are believed to be the most efficient installation yet completed and have exceeded the expectations and guarantees given, will in another 10 or 15 years be superseded by something better. For the time being, however, the Dominion Steel Company possesses a coke-oven plant, of which its officials are justly proud, nor is it to be expected that even the latest addition will supply the coke requirements for very many years to come.



Electric Locomotive coupled to Coke-quenching Car. Car is receiving charge of red-hot cake

The Turbo-Blower Installation at the Blast Furnaces of the British-America Nickel Corporation, Sudbury, Ont.

The following sketch Fig. 1 shows the arrangement of an interesting turbo-installation built in its entirety by the Dominion Bridge Company at Lachine, Que. to deliver air for the blast of the furnaces in which the nickel ore mined by the British-America Nickel Company at Sudbury is reduced to a matte for further treatment at the Refinery at Deschênes, Ottawa.

The extent to which the Dominion Bridge Company has engaged in the manufacture of steam-driven turbine machinery is not widely known, and it will probably be a surprise to many Canadian readers to know that this very compact and workmanlike unit was built, including the alternator, in the Bridge shops at Lachine. This department of the Bridge Company's activities is entirely distinct, and is in addition to the manufacture of water-driven turbines and paper-making machinery in which the Dominion Engineering Works engaged at the Rockfield shops.

In the British-America Nickel Company's blower unit, the five machines in continuous alignment consist of two groups.

At the left, a high-pressure steam turbine drives a 500 k.w., 60-cycle, 3-phase generator in tandem with a 30,000 cu. ft. blower, delivering air at about 36 ozs. per sq. inch.

The two remaining machines consist of a steam turbine connected to another blower of the same capacity as the first-named.

Under normal operating conditions, the blast is supplied by the last-named blower, but in the event of trouble on the outside transmission line, the other turbine and generator and the blower connected to them are put into operation, and the other blower is shut down.

By taking out the coupling bolts between the turbine and generator, the generator can be run as a synchronous motor at 3,600 r.p.m. to drive the blower next to it.

Each turbine is equipped with its own surface condenser, and condensate-removal pump. The steam-jet air-evactors, however, are grouped in a battery, and withdraw air from a trunk airline with branches to each condenser. This arrangement has been found to be very convenient in practice, as it makes the evactors interchangeable, and enables some to be shut down at light loads. The evactors also discharge into a common line; the outlet from which is submerged

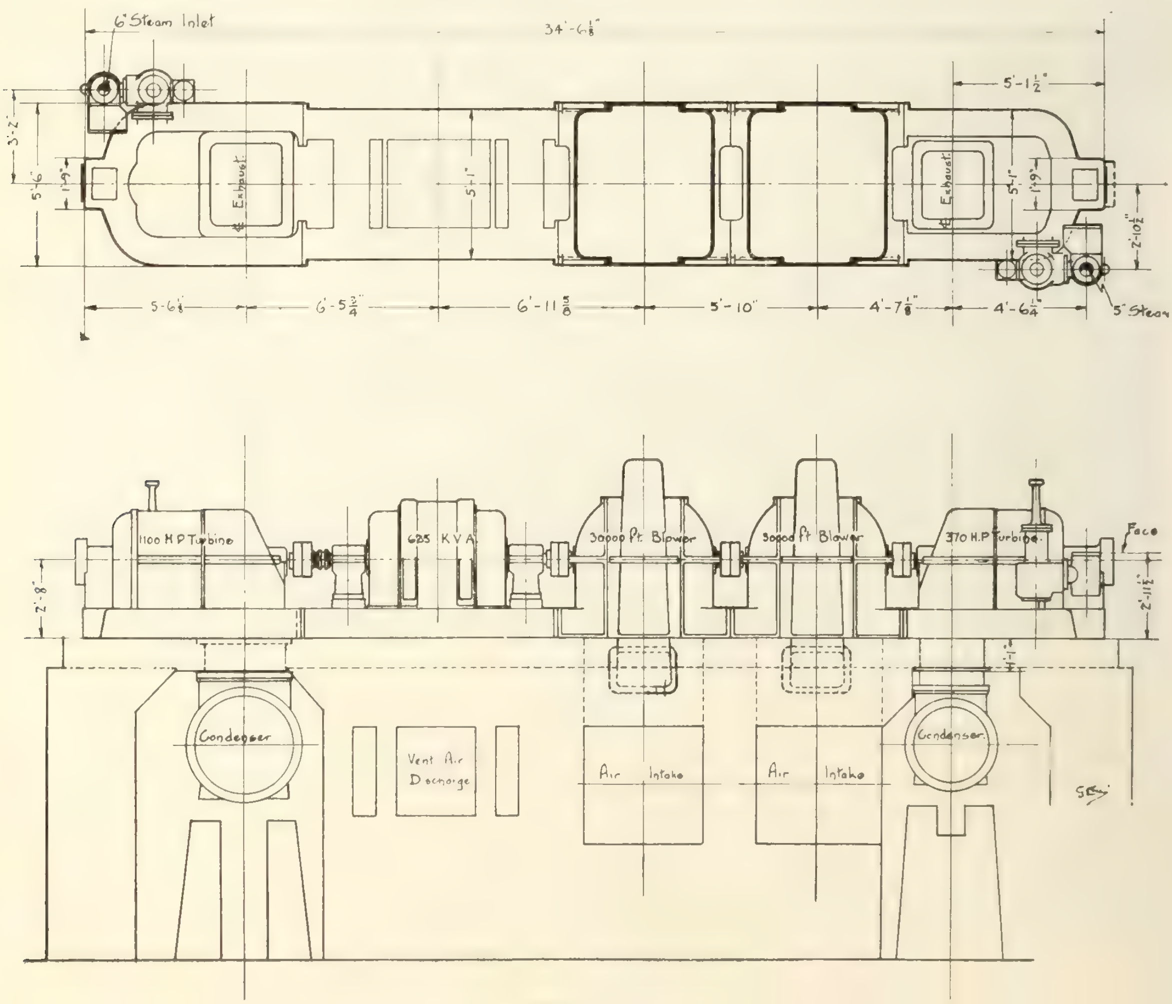


Fig. 1.

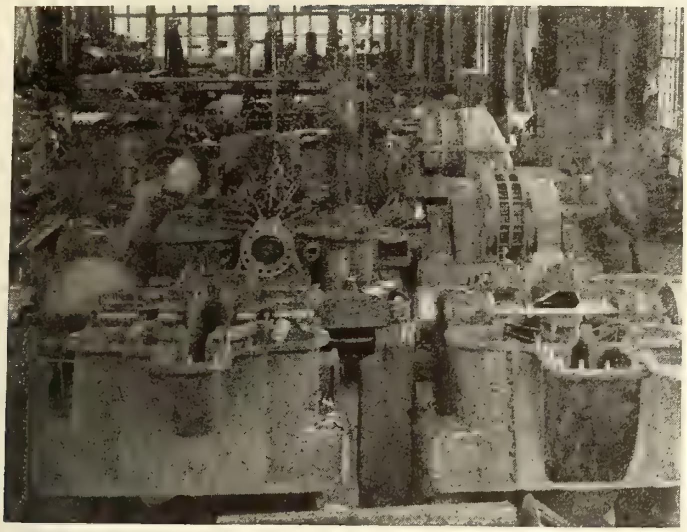


Fig. 2. Blower Installation under construction.

in a tank through which the condensate is pumped, the water being thereby raised in temperature, and the heat units remaining in the evactor steam conserved.

The air pressure delivered by these blowers is determined with certain limits by adjustment of the pressure regulators connected with the governor valve of each turbine. When once set, the turbo-blower will continue to give air at the desired pressure without further attention.

Fig 2 shows the blower installation in course of erection in the shops. In order from the foreground may be seen the following component parts of the unit, namely, the blowers, alternator and steam turbine. Fig. 3 shows the impeller for the 30,000 cu. ft. blower. The design of this impeller, the blades of which are securely slotted into the shaft, ensures complete freedom from vibration and an absence of end-thrust. The turbine machinery is all made under the Rateau-Smoot patents.

Fig. 4 is a photograph of a low-pressure wheel for a 2,100 h.p. steam turbine, (built for the British-America Nickel Corporation) on the static balancing-table.

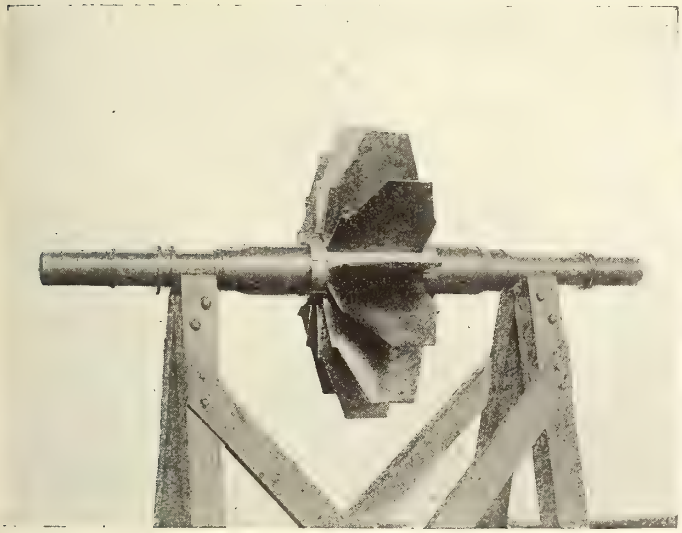


Fig. 3. Impeller for 30,000 c. ft. Blower.

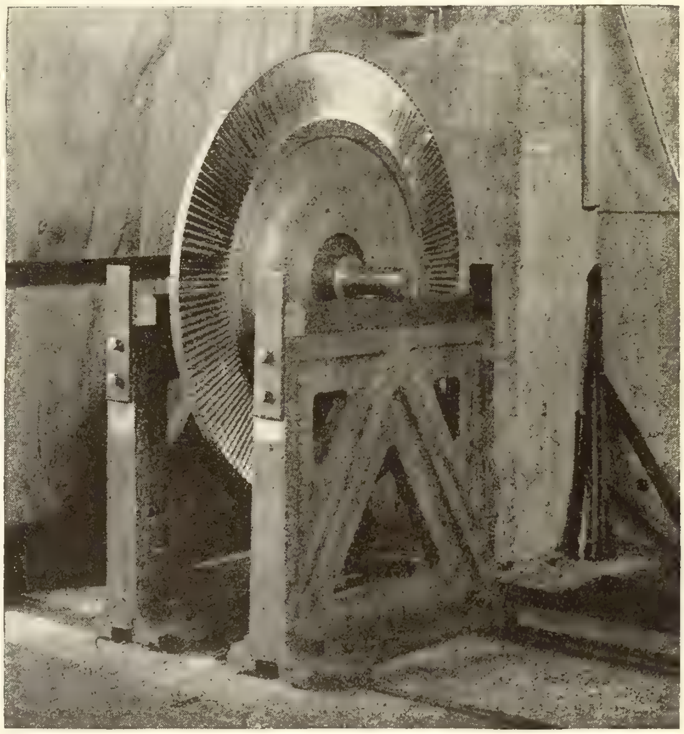


Fig. 4. Low-pressure Wheel of 2,100 h.p. Steam-turbine on static Balancing-wheel.

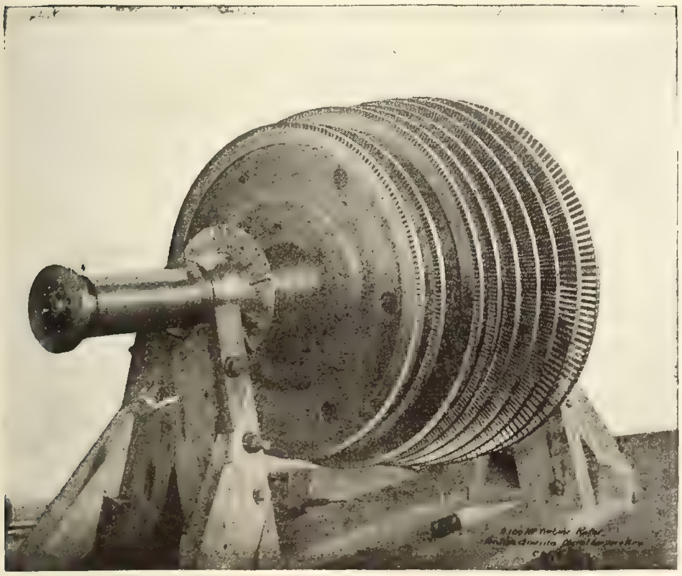


Fig. 5. Rotor of 2,100 h.p. Condensing Steam Turbine.

The rotor of a condensing steam-turbine, 2,100 h.p. is shown in Fig. 5. This is also for the British-America Nickel Corporation.

In Fig. 6 is shown a 400 k.w. alternator, designed to be driven by a non-condensing steam-turbine, that was built by the Dominion Bridge Co. for the Imperial Tobacco Company of Canada. It is direct-connected with the exciter.

The supercession of reciprocating-motion engines by the rotary engine for the furnishing of compressed-air as a motive-power, and for the furnishing of air-blast, is almost complete in all new construction, and it is not only interesting, but a matter for congratulation that Canadian machine-shops are in a position to supply machinery so modern in type, and so well adapted for the purpose, as the turbo-blower installation hereinbefore described.

The Importance of Cheap Power to the Industrial Life of Nova Scotia

Presidential Address by Colonel Thos. Cantley to The Mining Society of Nova Scotia, Glace Bay, May 4, 1920

Gentlemen:

Officers and Members of the Nova Scotia Mining Society, I bid you hearty greeting. The Mining Society of Nova Scotia is entitled to congratulations for the success which has attended its yearly gatherings during past years, and this Annual Meeting now in session in the chief mining centre of our Province, will, I doubt not, prove as important and profitable as any in our history.

The Province may also be congratulated on possessing a Society composed of its leading miners and metallurgists, active men mainly of the class known as practical, men for the most part not only practical, and of seasoned experience, but also of commanding personality, proved ability, with that resourcefulness which practice in mining and metallurgy in a new country, and in some respects an isolated country, demands and creates. Of such is the Mining Society of Nova Scotia—a body for many years composed of men who have perhaps done as much to advance the material prosperity of our native province as any similar group of men, given equal opportunity, have accomplished elsewhere.

In any remarks I may now make it is not my intention to refer to present business conditions, the labor situation, or the present world unrest. All of us naturally must look forward with some misgivings to the future—the immediate outcome of which is uncertain, but as to its final issue I personally have no doubt. Without a League of Nations, or in spite of one, men of the British breed can and will hold their own in the ship, the mine, the field, or the main. All these our fathers and our sons have worked, wrought, fought and sailed, and in all won the respect of our peers, and we have "aye been provided for and saw will we yet."

The custom of our Society is that your President should address the Society on some topic of mutual interest, yet pertinent to the community at large. Certainly there is no lack of problems that might with advantage be considered—and equally no doubt there may be many opinions concerning the subject most worthy of attention at the present time.

The mineral resources of the Province and the processes in the mining and metallurgical industry have been dealt with in their many and varied aspects, transportation and labor problems today have the eyes of the world focussed upon them—while familiarity with the laws and operations of high finance and so-called "big business," not to say mergers, is expected in all well informed citizens, and certainly assumed in industrial executives.

Possibly the most important remaining problem of wide spread concern to industry in Nova Scotia is the production of cheap power. And I have selected it at the subject of my address, treating it from an economic rather than from a strictly professional or technical angle, with a hope of perhaps better orientating our views on the situation in Nova Scotia at the present time. This position in one or more of its several forms, is of vital interest to most industries, which with cheap power may make considerable progress, but under the reverse conditions, will find it difficult to meet the competition of those more favorably supplied with this necessity.

The amount of power required and the relationship between cost of power and the cost of product vary a good deal, probably reaching a maximum in the electro-chemical industry—and the metallurgical processes used in the smelting, refining and manufacturing of metals.

In these cases power is one of the principal factors and reaches a requirement in the manufacture of certain chemicals of about 5,000 H.P. continuous load per 100 tons of raw material converted into finished product. Reference might be made in this connection to the recent discovery of salt near Malagash, the development of which makes the future establishment of important electro-chemical plants in the Maritime Proinces probable, provided cheap power is obtainable, as salt and coal are basic materials for such an industry, and a most important one it is.

In the electric steel furnace from 200 to 800 K.W. hours per ton treated is used, depending upon the materials charged and the degree of refinement required. Following these we have the more familiar application of power in iron and steel plants, mining and the transportation of materials where mechanical power originally was a secondary factor, but now has become of great importance as a means of increasing production and reducing costs, especially in countries where wages are high. And we find the power consumption amounts to 6 h.p. per ton of pig iron made in blast furnaces, 2 h.p. per ton produced in open-hearth steel furnaces, and 5 to 15 h.p. per ton of steel rolled in steel mills, depending in the latter case largely on the amount of work done in reduction, etc. In the further manufacture of steel into unusual shape, or where tonnage manufactured to any single section or pattern is small, this percentage may be appreciably increased.

In mining, where the power employed is steam and compressed air, the costs cover a wider range, and may reach from 10 per cent of the output for machine operated, heavy pitching, wet coal seams, to 5 per cent where the mining equipment is electrically operated. In metal mines, too, extreme examples may be cited—on the one hand in the case of rarer metals, given outputs of various magnitudes ranging from a comparatively few tons to several thousand per day, frequently located in inaccessible regions, and at points where a supply of fuel is obtainable only with great difficulty. The opposite type is represented by mines producing large tonnages under favorable conditions, such as our iron ore deposits where, on account of the nature of the materials to be mined, and the unusual thickness of the seam, lying at a moderate pitch, it is possible and necessary to use relatively large amounts of power for the operating of mechanical loading, trimming, and haulage equipment. Such a situation may demand 1 to 1½ h.p. per ton mined.

In the field of transportation, we have for land serice on steam railways an average figure of 3 h.p. per ton moved, with a fuel consumption of about one-quarter pound of coal per gross ton-mile. At sea one-

quarter h.p. per ton moved is required for bulk freight carriers, of moderate size, to one-sixth h.p. for the largest size, with coal consumption of 1¾ and 1½ lbs. per h.p. hour, and 0.045 and 0.032 pounds per ton-mile, respectively.

The principal prime movers in use at the present time are the reciprocating and turbine steam-engines, internal-combustion engine and the water-turbine. Each has its field of service, and under certain conditions is most economical, which fact must be considered together with its reliability for the service required. By way of comparison, the thermal efficiencies of each type considered as heat engines, may be stated as for modern steam-turbine installations of moderate size, 10 to 15 per cent, and in the case of the largest modern units 15 to 21 per cent. Engines using blast-furnace gas 18 to 26 per cent, while with the full Diesel type of oil engine 33 per cent is obtained, even in small units.

The improvement in thermal efficiency of what is as yet the greatest of our prime movers—the steam engine—during the past 220 years, has been really great. Beginning with the year 1700 Savery's engine then required 40 lbs. of coal per h.p. hour. Newcomens' engine, introduced in 1711, required 55 lbs. Watt's engine of 1778 required only about one-quarter of these amounts, or nine pounds per h.p. hour. The Cornwall engine of 1844 again divided this quantity by three, or to be exact, 3.2 lbs.. Higher pressure and greater ratio of expansion some years later reduced this to two pounds, and in the first decade of this century to 1½ lbs. The turbo generator of 1903 demanded a consumption of about two pounds—fifteen years' study and the outcome of designing experience brought the coal consumption of the turbo-generator in large units down to one and one-tenth pounds, and it would be very unwise to predict that that figure represents finality in that direction.

In Nova Scotia our principal source of power is coal used directly, or indirectly in the form of waste heat from coal in gas fired furnaces, and burned under boilers to actuate steam engines. In the Sydneys, blast-furnace gas might be used to actuate steam engines, while water powers of moderate size are available in various parts of the Province. In some districts use might be made to advantage of oil-driven engines of the internal-combustion type, but it now seems probable that this will be limited to requirements taken care of by small units due to the rapidly increasing price of fuel oil. In view of the efficiency of this type of engine and the other advantages this method of producing power affords, the shortage of fuel oil is regrettable—and a situation already serious is being augmented by the increased use of oil to generate steam in the merchant marine.

As the amount of oil available is far from inexhaustible, and it is a natural resource not replaceable by any known means, we are faced at the present rate of increase in consumption with finding the world's oil reserves depleted before many years, and the problem of finding a substitute is important. Tar, toluol, and other coal distillation products are now being used to replace natural fuel oils, but while this practice will undoubtedly increase, their source is also circumscribed, due to their being the by-products of coal. What is needed is a fuel capable of replacing them produced from vegetable products. Crude alcohol meets these requirements, and as it may be produced in quantity by systematic cultivation without depletion of natural resources, this problem is one deserving serious attention by governments and departments of conservation.

The situation may in the future be materially relieved by the development of our oil-shale resources, which show marked indications of considerable extent in some districts of this Province, and as they can be mined cheaply, speaking generally, it should be only a short time when these resources will be utilized.

The power of the tides now wasted in the Bay of Fundy, and its tributaries, has received considerable attention from time to time. In our opinion the scheme of this development by the use of two tidal basins is technically practicable, where the land features are such that basins of requisite capacity can be built at a reasonable cost. The initial expenditure would, of course, be great, but so would the power. With the increasing scarcity of fuel and demand for power this source of energy will surely be put to practical use in the future.

In addition to these there are rather indefinite possibilities in the use of peat, which will be of great local value in Newfoundland and elsewhere where there are extensive deposits, when we have learned how to utilize its heat value economically.

While the use of blast furnace and coke-oven gas in internal-combustion engines has been to a very considerable extent tried out, and is still used with success in some localities, such use of these fuels locally seems problematical, especially where the gas can be used to advantage for heating purposes, as the capital expenditure for a gas engine-driven plant of reasonable reliability is very high, and while it is true that the fuel used per unit is still lower than the most efficient steam-driven units, this difference is now very small, as compared with the figures of a few years ago, due to the relatively greater advance made in steam turbines designed for the higher range of steam pressures and superheat; and the higher efficiencies now obtained in the regular boiler room practice where 76 to 78 per cent is maintained without the use of economizers.

Having briefly outlined the probable sources of power, it will be of interest to take up the question of cost production. In consideration of this phase of the question, the cost of electric current generated by steam power plants will be first taken up, and as we all have, to some extent, a conception of the operating cost of most common units, we will not deal with them other than to point out the marked variation in the coal consumption, which is the principal item.

The average consumption of coal per K.W. hour with compound expansion engines of the best type, condensing, ranges from 2½ to 5½, perhaps 4 lbs. might be taken as a fair average, equivalent to, say, 7 per cent efficiency. In the case of non-condensing engines, simple and compound, such as used for pit-winding and rolling mills and similar class of factory engine, where power is distributed by shafting, ranging from 5¼ to 8 lbs., averaging 6¾ lbs., or an efficiency of, say, four per cent.

Miscellaneous small engines, steam pumps (the former located where power is required all over factory and engineering shops, deriving steam through a long system of pipes) probably take from 10 to 20 lbs. or more, and would not average less than 13 lbs., or, say, 2 per cent efficiency.

The efficiency of the units of the two last mentioned classes is so low that their use should be restricted where possible for more economical means,

although there is a field for their usefulness within certain limits in plants using large quantities of low pressure steam for the purpose of heating.

Within the last five years large central steam-driven stations received close study as an important factor bearing on the conservation of coal, and the possibilities of obtaining relatively low cost electric power from this source has been fully demonstrated in both the United States and England. The unusual size of these stations should be kept in mind, as generators of 20,000 to 45,000 K.W. are used, and units of over 60,000 K.W. are building, indeed, if not now actually operating, and size has a most important bearing on power costs.

With the use of somewhat smaller units the efficiency, while not as high, is closely approached—as is shown from the operating cost of a central station of this class—which has a switchboard cost for the year ending December, 1916, of 0.262 cents, and for a later period of three months of 1917, when coal was more expensive, of 0.360 cents.

In Table No. 1 the first column shows the various items entering into the switch board costs here referred to, and opposite it is a revised cost using native coal at $5.00 per ton, also allowing for increase in labor and supplies and showing a cost of 0.528 cents per K.W. hour for local conditions:—

TABLE I.

For Three Months Ending March 31, 1917.

	Expense per K.W. hr. Original.	Expense per K.W. hr. Corrected for local conditions.
Superintendence	.009	.009
Wages	.050	.056
Coal	.264	.418
Lubricants	.001	.0015
Station Supplies	.005	.006
Station Buildings	.013	.016
Steam Equipment	.016	.019
Electrical	.002	.0024
Total	.360c	.5279c

For year of 1917 corrected column based—
Labor increased 12½ per cent.
Fuel increased $5.00 per ton.
Lubricants, Supplies, etc., increased 25 per cent.
Maximum demand (20 minutes), 45,000.
Average load, 25,300.
Total K.W. hours, 54,654,900.
Coal per K.W.—pounds, 1.56 lb.
Total cost coal, $144,735.71.
B.T.U. per K.W.H., 20,300.

Twelve (12) *Months Ending December* 31, 1916.

	Expense per K.W. hr. Original.	Expense per K.W. hr. Corrected. for local conditions.
Superintendence	.013	.013
Wages	.042	.047
Coal	.174	.391
Lubricants	.001	.0015
Station Supplies	.006	.007
Station Buildings	.007	.0087
Steam Equipment	.016	.019
Electrical "	.003	.0037
Total	.262c	.4909c

For year of 1916 corrected column based—
Labor increased 12½ per cent.
Fuel increased $5.00 per ton.
Lubricants, Supplies, etc., increased 25 per cent.
Maximum demand (30 minutes) 36,000.
Average load, 18,500.
Total K.W. hours, 162,117,600.
Coal per K.W., pounds, 1.45 lb.
Total cost coal, $262,135.47.
B.T.U. per K.W.H., 19,800.

These figures do not include interest or depreciation.

It might be well at this point to refer to the differences in cost of power due to variation in local conditions. It will be apparent that high peak loads require reserve generating capacity in proportion to their magnitude, and this condition may apply to boiler capacity also, and when for this reason the ratio of the average station load to short period peaks is low, and we have a low load factor, this results in increased capital expenditure and operating costs. This has an important bearing, as this factor varies considerably under different conditions, and a considerable diversity in industries is desirable when locating such a power unit.

The magnitude of the plant, the costs of which we have given ranging as they do to 200 million K.W. hours per year, is considerably in excess of the requirements of our industrial centres at the present time. The consumption of electric current in the Sydney district, is, say, about 100 million K.W. hours while in Pictou County forty million K.W. per year will possibly take care of present requirements. These smaller outputs materially affect the cost of production, and in order to show the extent of this effect the following estimate is submitted to demonstrate what practice might be expected under present day conditions, using local fuels.

Plants of three different capacities are given producing 46, 72, and 126 million K.W. hours a year, and at a switchboard cost of 1.07, 0.903 and 0.877 cents per K.W. hour, respectively.

TABLE 2.

Station Power Costs.

Items.	Plant A. Costs. Cents K.W.H.	Plant B. Costs. Cents K.W.H.	Plant C. Costs. Cents K.W.H.
Operating—			
Labor	.204	.101	.065
Material	1.16	.756	.701
Maintenance—			
Labor	.0411	.037	.038
Material	.0784	.018	.070
Total Labor	.2021	.138	.103
Total Material	1.238	.754	.771
Total Labor & Material	1.446	.892	.874
Other Items	.025	.011	.003
Total	1.071	.903	.877

Net output in mill K.W.H.			
Month	3.84	6.14	10.5
T'l power gen. mill. K.W.H.			
including auxiliaries . .	4.04	6.21	10.6
Lbs. coal per K.W.H. . .	3.78	2.68	2.18
Cost of coal 2,000 lbs. ($)	5.00	5.00	5.00
Load factor Machine p.c.	49.0	59.6	64.56
Load factor, 15 min. max.	55.0	45.3	36.37
B.T.U. per net K.W.H.			
Output	43627	28289	30716
Net K.W.H. per yr. (mill)	46.08	75.26	126.0

Another source of power might be made available by the development of our water powers. There are within the Province a number sufficiently large which if developed, would provide several moderate sized if not large units of electrical energy. While some of our larger rivers and a number of smaller streams have not been investigated in detail, the Nova Scotia Power Commission are of the opinion that 300,000 h.p. may be ultimately developed, and if the present programme as we now understand it is carried out, we may have soon installed transmission systems supplying the greater part of the Province, with the exception of the extreme Eastern section.

A considerable section of the public sometimes referred to as the "man on the Street," has a general idea that water power, in view of its being a natural product, provided by Nature and annually replaced, must therefore provide energy at the lowest possible cost. Unfortunately, however, the cost of such industrial power depends upon a considerable number of factors, and none of the energy possible of development at any of the Nova Scotia streams can be made available to the various manufacturing establishments, and our towns and villages, except as the result of very considerable expenditures in the way of extensive dams, storage barrages, the installation of expensive hydro-electrical machinery, and a considerable mileage of transmission lines, and while operating expenses in one direction are low, the interest charges are bound to be high and these must be met.

So far as the cost of water power is concerned, we find that the tentative estimates made by the Commission suggest a total cost including fixed charges and operation of 0.7 cents per K.W. hour for the St. Margaret's Bay development. This plant is now under construction and is expected to supply the Halifax district with a possible thirty million units per year.

Another possible development, and in this case of very considerable importance to Pictou County, is that of Sheet Harbor on East River, St. Mary's. From this development we are advised the estimated total cost of current delivered at a point in the vicinity of New Glasgow would be three-quarters of a cent for a total consumption of thirty million, or 1.10 cents for twenty million K.W. hour per annum. Indeed, it is stated that the output can be increased to 45 million K.W.H. at a cost of one-half cent per unit, when such a hydro system is completed, and tied together in a manner which will permit an exchange of current from one development to another. It is to be understood that these prices are based on delivery in the quantities mentioned at transmission line voltage, to a distributing station, and would approximately apply to a very large consumer, but would have to be increased to cover local distribution in order to serve the smaller industries located in a town using current at lower pressure.

The proposed systems will ink up many of the towns and pass through agricultural districts of the central part of the Province supplying current at a rate which would materially aid in the development of the country, and increase production along many lines.

A great deal has been written on the subject of coal ternal combustion engines of the Diesel type, burning crude oil, especially for marine work, and certainly oil has many advantages over other kinds of fuel, either when used direct in the cylinder of an engine or by combustion under steam boilers. Unfortunately we are to a large extent prohibited from its use in recent years on account of its high cost.

In the isolated locations where freighting of coal is a serious expense or storage a determining factor, or in cases where boiler feed-water supply is lacking, there is still a field for its use, and we have under these conditions, a very satisfactory and highly efficient plant in engines of the full Diesel and semi-Diesel type, particularly if they are operating under constant load or very light overloads.

As an indication of the operating cost to be expected in a small plant, we give the following figures from a station with semi-Diesel engines, having an output of about 130 thousand K.W. hours per month, where is the fuel oil consumption is in the vicinity of .0936 gallons per K.W. hour, or which based on the present cost of oil sixteen cents per gallon in tank car lots, the fuel cost is 1.50 cents per K.W. hour.

An engine of the full Diesel type would give lower cost figures to some extent—the difference of the two types being represented by consumption of 0.40 lbs. per B.H.P. hour for the Diesel against 0.50 lbs. for the semi-Diesel type. Greater allowance in both types would have to be made for repairs and maintenance than in the case of steam plants.

The figures given in our estimates of cost are for power delivered at switchboard, which will be increased by distribution cost necessary to deliver the current to the ultimate consumer. Owing to the loss in transmission, cost of equipment and maintenance, this charge will depend, on the distance, quantity of current to be transferred and type of service, and the costs vary considerably. It is usual, however, to have losses of from ten to ewenty per cent on power consumed in quantity—while two to five cents per unit is added in the case of current delivered within city distribution system for lighting service.

In estimating the possible saving it will be apparent that two principal classes of power consumers, must be considered. First the large independent manufacturer whose requirements are sufficient to warrant operating an independent power plant. The other, the general consumer, dependent on a public course of supply, whose present cost of power probably varies from three to seven cents per K.W.H. It will be apparent that under any unification scheme that the saving to the latter class will be very great.

Some idea of the overall saving that may be effected will be given by the results obtained by the North-east Coast Electric Power Scheme which supplied power to the largest industrial area in England. It is stated that the average price paid this company for current totalling one-third of a million horse-power a year delivered at the customer's terminals, is less than one cent while the coal consumption is 2.06 lbs. per K.W.H. It has been estimated that this latter figure has replaced former coal consumption of 9 1-5 pounds when various industrial establishments now

connected with the power scheme generated their own power individually.

As power plays so important a part in manufacturing, it is a factor next only to those of fuel, market and transport costs in deciding the location of a factory. At the present time while we have the coal power it is relatively dearer in Nova Scotia, and it is only to be had by installing the necessary power plant to meet each individual requirement. This is a decided handicap to the manufacturer starting a new business, and at best gives very expensive power. It surely is apparent that if manufacturing in Nova Scotia is to develop in a satisfactory degree some effort must be made to improve the situation.

From the figures already given it is evident that large production of power is essential to low costs, whether steam or hydro-electric, and the fact that large central steam plants are now being worked and others developed in the United States and Great Britain, confirms this view. Here, as in most cases of human endeavor, unity is strength, and need for all working together is self-evident.

It is important in this connection that all power users should, where possible, employ electric equipment of the same frequency. Unfortunately, this is not the case today, as in two instances in this Province we have practically adjoining districts using current which is not interchangeable without the use of frequency converters, and in this connection it is worth mentioning that the Nova Scotia Power Commission proposes using 60-cycle generating equipment in their various developments. While differences in voltage is not so serious, it should also be given consideration, and limited to as few standards as is economically possible. Standardization would also simplify the local suppy of electrical equipment and make neighbors a more dependable friend in the day of spare part troubles.

Some of the larger companies in the Province have a surplus of waste heat or electric generating capacity or both, and could supply power to manufacturers in their locality at a comparatively low cost. Power sold in this way would tend by increasing total production to reduce the cost per unit, and such a policy would have the effect of stimulating the growth of associated subsidiary and smaller trade in the community, and in time build up an important market near at hand.

The situation in this Province from a manufacturing point of view is in some important, if not vital, respects far from favorable. We are situated far distant from the chief consuming centres of the Dominion, and while the cost of transport per ton-mile in the past has not been high, the distances involved have been so great as to make the transport cost a very large factor, particularly in the case of coal and heavy manufactured products, such as iron and steel During the past few years the cost of railway operations has very largely increased, and is still advancing and there is little reason to hope for much improvement in this connection.

If Nova Scotia is to advance along manufacturing lines and so provide employment giving a satisfactory return both to labor and capital employed, it is absolutely essential that power be supplied not only to our large but also to our smaller manufacturers, at rates at least as favorable as those enjoyed by like industries in the other Provinces of the Dominion.

A really economic national policy must be based on the necessity of using our coal for such forms of work as cannot be performed with other sources of energy. While our coal reserves are large they are not inexhaustible, and after that section of our deposits which are immediately available is worked out, the cost of production will increase as our mines and workings become deeper and more extended. The question of man-power necessary to work over the greater and more extended areas of production, when the deposits near the surface are exhausted, is another factor which cannot be overlooked. In view of these considerations we must so far as possible obtain our supply of energy by increased development of hydro-electric generation of power, reserving our fuel supplies for the reduction of our iron and other ores, and the purifying treatment and manufacture of metals, which cannot be accomplished save by the agency of heat, whether this be supplied by solid or gaseous fuel.

To this end all should work together to improve the situation, and to enlist public interest in this subject of vital importance—which we gladly note is now commanding the attention of the Government of this Province, with, we trust, the likelihood of helpful results.

FIRST WESTERN MANUFACTURED TRACTOR

The "Canadian," a Canadian built tractor, manufactured as far west as Medicine Hat, Alberta, is the achievement of the Alberta Foundry and Machine Company, Ltd., which represents a total investment in the city and district of a quarter of a million dollars. Except the mechanical oiler, magneto, carburetor and radiator, all of which are patented, the "Canadian" kerosene tractor is manufactured entirely at Medicine Hat Plant.

The tractor which will haul three ploughs, in breaking, and is claimed to be one of the cheapest for its power in Canada, already has a demand which exceeds the supply. The fifty recently assembled had purchasers waiting for them and they will all be on land this summer. Tests have proved the machine to give entire satisfaction and it is expected that by the end of the year the plant will be turning out ten per day. This is the first manufacturing plant of its kind west of the Great Lakes and marks an epoch in the West's manufacture of agricultural machinery it uses so extensively.

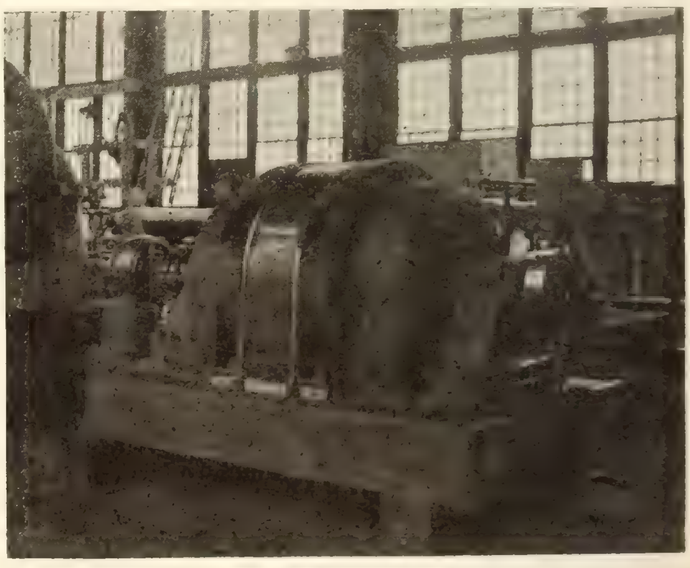


Fig. 6. 400 K.W. Alternator, built by Dominion Bridge Co.

Company Notes

DOMINION IRON AND STEEL COMPANY

The Plate Mill is working to capacity, a record day's production of 218 tons of plate having been recently obtained. There is no lack of market for plates at this time, and it is understood that several projected steel ships are deferred in commencement at St, Lawrence plants because of the difficulty in obtaining delivery of ship-plates.

A number of the views of the mill in operation are included in this issue. The Mill has been very fully described in previous issues of "Iron and Steel," but photographs of the various units in completed condition have only recently been available.

The rod and bar mill, nail-mill, and other departments of the Sydney Plant are fully employed. The rail-mill has been idle for some time.

The machinists of the Plant have been on strike for some weeks.

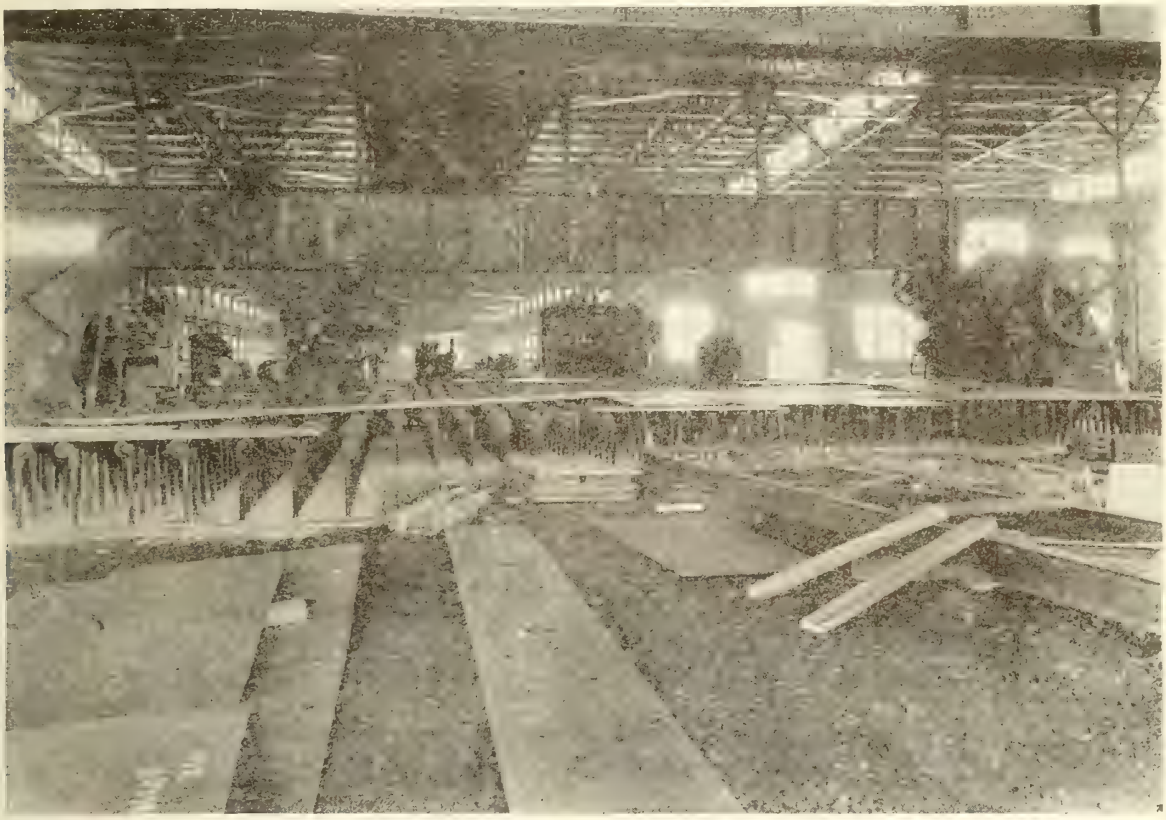


Plate Mill, Dominion Iron & Steel Co., Sydney. Castor Floor, showing on left 156" Slitting shear, and on right, 144" Shear

ALGOMA STEEL CORPORATION PROGRESS AT THE SAULT PLANT

Work on the construction of the structural steel mill has already been commenced by the Algoma Steel Corporation at Sault St. Marie and it is believed that the work will be completed inside of the next twelve months. The estimated cost of the mill is $7,000,000 and equipment will be installed that will enable the Corporation to produce structural steel shops up to 24-inch channels and beams. Ultimately it is intended to produce 27-inch beams, when the demand is sufficiently large to warrant it. At the outset the Corporation plans to produce one-third of the total requirements of theDominion. In addition to the initial output of 100,000 tons of structural steel, it is planned to roll the greater part of the Corporation's rail products in the new mill. Thus, within the next year the output at the Sault will be raised from 300,000 to 400,000 tons of steel per year, and the number of men on the pay roll will be raised from 3,000 to 3,600.

Steel rails are rolled in the present mill up to 105 lbs. section. It is the intention now to provide for the rolling of rails up to 125 lbs. in the new structural-steel mill. The four blast furnaces have a monthly capacity of 45,000 tons of pig iron and the by-product coke ovens have a maximum output of 45,000 to 50,000 tons per month.

NOVA SCOTIA STEEL AND COAL COMPANY

The steel operations of Scotia, both at Sydney Mines and at New Glasgow, are reported to be at full capacity.

PLANS OF BALDWINS, LIMITED AT ASHBRIDGES BAY, TORONTO INTERFERED WITH BY INABILITY TO OBTAIN POWER.

Contract work on the new plant of Baldwins Limited at Ashbridges Bay, Toronto, has ceased, owing to inability to secure sufficient power from the Hydro system, and officials of the steel company declare that they will be compelled to move away from Toronto unless more power is forthcoming. The statement was made by A. M. Russell President of the Company, that unless negotiations for more power, now in pro-

gress with the Hydro-Electric Power Commission, resulted satisfactorily, the plant would have to be abandoned. A total of 20,000 horse power is wanted, and although no contract had been made for this amount it had been understood that the necessary power would be forthcoming. Mr. Russell has cabled to the directors in England informing them of the situation and has intimated that it may be necessary to move the plant to the Province of Quebec. The Chief Engineer of the Commission states that although the company were asking for a very large amount of power, it was thought that eventually they would get it. Sir Adam Beck, who is not held accountable in any way for the shortage, is expected to make a statement when he returns to Toronto in a few days from London.

Toronto—

In view of the fact that no tenders have been received for the purchase of the 13-acre property of the Polson Iron Works, Limited, in Toronto, the Master-in-Chambers will probably now authorize the liquidator to dispose of the plant by private sale.

The Canadian General Electric Co., has awarded contract to the Peter Lyall Construction Co., 61 Front Street West, Toronto, for a manufacturing plant to cost $250,000.

Bastian-Morley, Ltd., Toronto, has been incorporated with a capital stock of $300,000 by James P. Morley, Oliver A. Ludlow both of Laporte, Ind.; John M. Godfrey, Toronto, and others, to manufacture stoves, heaters, furnaces, lighting and heating systems, etc.

Key-Bolts & Rail-Anchors Ltd., Toronto, has been incorporated with a capital stock of $150,000 by John A. Kent, room 43, 44 King Street West; Guy M. Jarvis and others to manufacture machinery, tools, etc.

The Ductite Steel Company, Limited, has been granted a charter with power to carry on the general business of iron masters and allied industry, the provisional directors being: John A. Kent, G. M. Jarvis, E. M. Gardiner, C. V. Beale, B. Cameron, E. A. Croker and A. M. Hyndman, all of Toronto. The authorized capital is $1,500,000.

Welland—

Canadian Steel Foundries to Re-open Plant.—The Canadian Steel Foundries of Welland, whose plant has been closed down for about a year will shortly recommence operations, according to an official statement. The rolling mills will engage in the manufacture of steel bars and angles as previously, but no couplers and parts will be manufactured. Miscellaneous castings will be turned out. Mr. Fred Curtin has returned to Welland from Hamilton to take charge in his old position. The plant is expected to employ about 700 men when it is running to full capacity and by June 1st 300 men will be required.

Canadian Foundries and Forgings, Limited, announce that their Canadian Billings and Spencer plant at Welland after a couple of weeks shut-down on account of a strike, has once more resumed operations in full swing, the employees having agreed to the company's terms, the employees having agreed to the coming day from an eight to a nine-hour basis.

Brantford—

The Dominion Steel Products Company, of Brantford, Ont., have been authorized by their shareholders to increase the capital stock of the company from $1,000,000 to $1,500,000. The increase is to cover necessary extensions to the plant in the Holmedale district of the city, including foundry and machine shop additions. Bright prospects for the future were outlined at the meeting of shareholders which was largely attended.

The A. C. Spark Plug Co., a subsidiary of the General Motors Corporation, will establish a manufacturing plant at Brantford, where a site of 16 acres has been purchased. Construction will start at once and it is expected to be completed in 60 days.

The Lundy Dustless Street Sweepers, Ltd., has been incorporated with a capital stock of $250,000 by James Harley, Edmund Sweet, and others to manufacture machinery for street sweeping and road making, motors, engines, boilers, etc.

McClary Manufacturing Company has purchased the stove and furnace manufacturing business of the William Buck Stove Company of Brantford. The Buck Company has been operating continuously since 1852.

Paris, Ont.—

The G. W. MacFarlane Engineering, Ltd., has been incorporated with a capital stock of $500,000 by George W. MacFarlane, Paris; Edward H. Ambrose, John R. Marshall, Hamilton, Ont., and others to manufacture machinery, castings, tools, etc.

Waterloo, Ont.—

The International Engineering Corporation, 95 King Street, East Toronto, will erect a foundry and machine shop here. It has secured a 5-acre site, and will erect three one-story buildings, 50 x 100 ft., to manufacture a line of crude oil engines. A. M. Castle is president.

Petrolia, Ont.—

The Draper Mfg. Co., Port Huron, will re-open and enlarge its plant which was closed some time ago. It manufactures valve facing tools, ball check valves, ball globe valves, balanced brass balls, etc. Operations are expected to begin in about two months.

Galt, Ont.

The Elliott & Whitehall Machine & Tool Co., will start work at once on the erection of a plant on a site of two acres where it will manufacture its line of milling cutters and small tools, metal stamping dies, jigs and fixtures. It is expected that the plant will be in operation by next September.

Peterboro, Ont.—

Th Canadian General Electric Co. has let the general contract for addition to its plant and equipment at Peterboro, Ont., to John E. Hayes, 219 Park Street, to cost $500,000.

Guelph, Ont.—

The Gibson Mfg. Co., Guelph, Ont., manufacturer of gas engines, tractors, etc., is building a two-story addition, 80 x 140 ft., to its main building, to be used as a machine shop and assembling room. The company recently completed an extension to its molding shop.

Hamilton, Ont.

The Norton Company of Worcester, Mass., announces the establishment of the Norton Company of Canada at Hamilton for the manufacture of grinding wheels for the Canadian market. Robt. C. Douglas is manager, and deliveries are scheduled for May 15th.

New Brunswick—

Plans have been prepared for the construction of a railway bridge across the St. John River, the new location of the C.N.R. tracks. Work will probably start some time this year, and, while various figures have been mentioned, it is said that the lowest figure calls for an expenditure of more than $2,000,000.

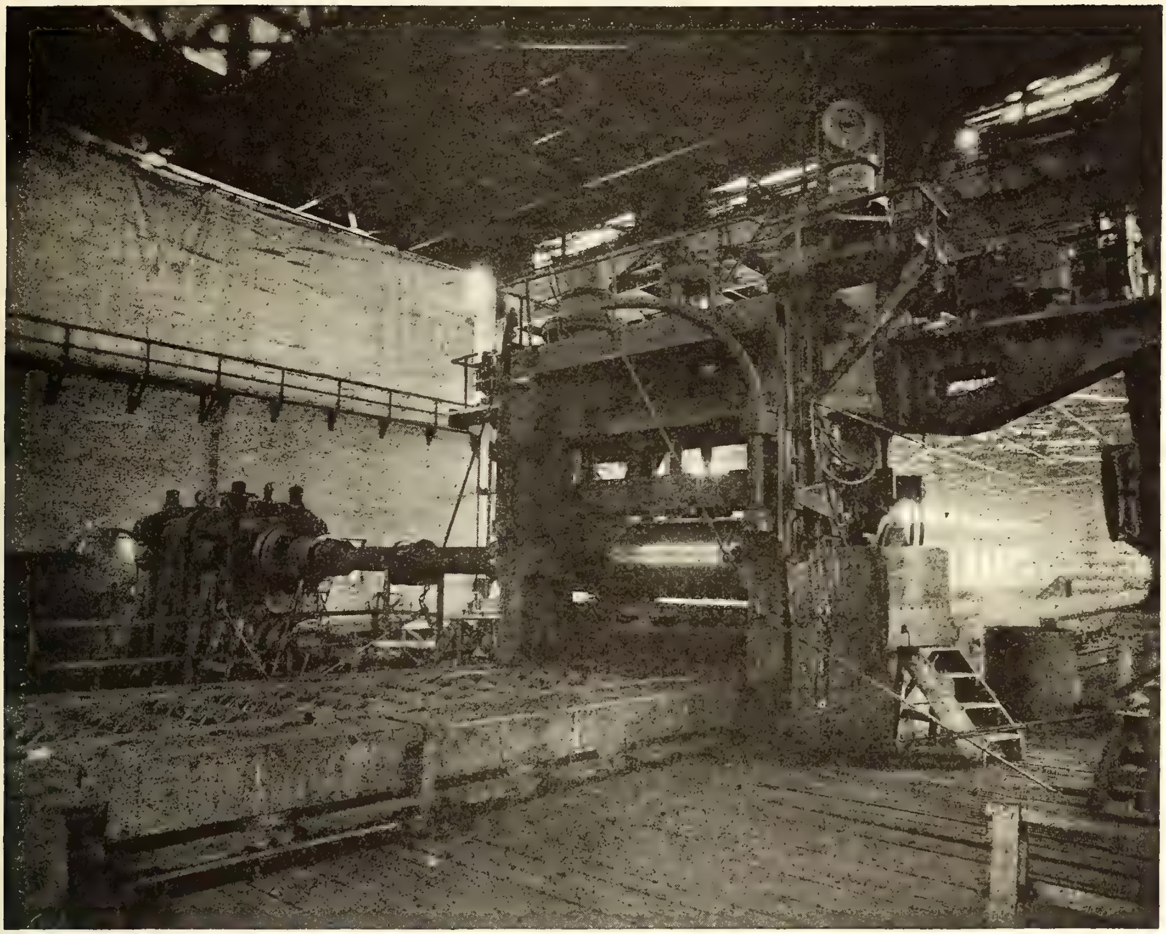


Plate Mill, Dominion Iron & Steel Co., Sydney. Showing Main Rolls.
Motor Room is on the left

Plate Mill—Inspection Table. Arms are shown down, but can be raised to show bottom side of plate at angle of 45 degrees

Plate Mill—Plate Leveller and Transfer Table (looking down to Castor Table and Shears)

Moncton—

Fire destroyed a large portion of the plant of the Record Foundry and Machine Company on the 26th May. Loss covered by insurance, is estimated at $75,000.

Winnipeg

The Cuthbert Co., Ltd., has been incorporated with a capital stock of $100,000 by John S. Blair, Homer E. Morrow, Henry E. Ryan, and others to manufacture mechanical devices, machines, machinery for loading and handling grain, farm implements, etc.

Officials of the Manitoba Electric Power Transmission Commission announced that it is estimated there will be expenditures in development work this year approximating $600,000, including the construction of a power plant at Virden at an approximate cost of $75,000. Commissioner, J. M. Leamy.

Montreal

The Rapid Tool & Machine Co., Ltd., Lachine, Que., has been incorporated with a capital stock of $500,000 by John MacNaughton, Robert Dodd, James G. Cartwright and others to manufacture gages, tools, motors, engines, machinery, hardware specialties, etc.

Contracts have been let for the erection of nine factory buildings at Montreal, for the Canadian Pacific Railway, Windsor Station, to cost $1,250,000.

The Berliner Gramaphone Co., St. Antoine Street, has awarded contracts for the erection of a factory costing $400,000. The Atlas Construction Co., 37 Belmont Street, has the contract.

An addition is being made to the Angus, Que., car shops of the Canadian Pacific Railway and new machinery will be installed. The total cost will be approximately $1,000,000.

An extension of the Angus shops of the C.P.R., practically doubling their capacity, is shortly to be undertaken, the necessary plans and specifications having been filed at the City Hall. One million dollars is the estimated cost of the proposed work, which calls for the building of extensions to the passenger and freight car building plants as well as the repair and machine shops.

Three Rivers, Que.

Plans are being prepared for the erection of a malleable steel foundry at Three Rivers, Que., for the Mechanical Engineering Co., to cost $75,000. Mr. Ditchfield, care of the company, is engineer.

The St. Maurice Paper Co., Cap De La Madeleine, Que., contemplates the expenditure of $500,000 on the construction of a grinding mill and the installation of machinery. A MacLaurin is general manager and D. V. McSweeney, purchasing agent.

Sherbrooke, Que.

The Sherbrooke Machinery Co., Dandell Street, Sherbrooke, Que., has awarded the general contract to the Loomis Construction Co., 7 Belvidere Street, for an addition to its machine shop to cost $26,000.

Nova Scotia

The Sydney Foundry & Machine Co., Sydney, N.S., plans improvements to its foundry to cost $8,000.

The J. W. Cummings Co. of New Glasgow, N.S., plans additions to its works, including an electric furnace. This company manufactures miners' tools, ship parts, etc. J. W. Cummings is president.

REPORT OF DOMINION STEEL CORPORATION FOR 1919.

The Report of the Dominion Steel Corporation shows production during the fiscal years 1918 and 1919 as follows:

	1918. Tons.	1919. Tons.
Pig iron	307,863	184,229
Steel ingots	341,603	219,943
Blooms and billets	47,890	26,165
Standard rails	164,972	28,976
Light rails	......	3,319
Wire rods	26,746	44,436
Bars	1,459	1,245
Wire (includes used in making rails)	6,043	15,542
Nails	5,508	12,386
Plates	......	3,252
Coal	3,622,644	3,502,069

The Report states with reference to production:

"Although every possible effort was made by your directors and the officers of the Dominion Coal Company to maintain the output of the collieries, it was somewhat less than that of last year. The total production from all collieries for the past five years was as follows:

Year ending 31st March, 1920, 3,502,069 tons; March 1919 3,622,644 tons; March 1918, 3,781,615 tons; March 1917, 4,279,772 tons; March 1916, 5,261,198 tons.

"On account of trade conditions operation of the steel company's works was greatly restricted during the months of August, Septemebr, October and November, and in consequence the year's output of steel was correspondingly reduced. During the last quarter of the fiscal year operations were gradually increased and are now upon a more satisfactory basis.

"It will be noted that a new item has been added to the list of materials produced and that steel plates are now being made in quantity."

The net addition to value of properties during the year amounted to $4,329,043, principally represented by the erection of the plate mill, additional electric power equipment at Sydney plant and at the Wabana mines, and improvements to the collieries and power systems of the collieries in Cape Breton and at Springhill.

The profit and loss account for the fiscal years ending March 31st compare as follows:

	1919	1918.	1917.
Op. income	$5,532,529	$8,768,054	$11,030,112
Depreciation, etc.	1,266,856	1,304,323	1,384,242
Balance	$4,265,673	$7,463,731	$9,645,870
Interest	1,004,060	1,013,263	1,064,209
Net income	$3,261,613	$6,450,468	$8,581,661
Pref. dividends	420,000	420,000	420,000
Do. other Co.s.	560,000	560,000	560,000
Net profits	$2,281,613	$5,470,468	$7,601,661
Com. dividends	2,029,629	1,765,373	1,444,397
Surplus	$ 251,984	$3,705,095	$6,157,264
Prev. surplus	7,959,252	13,754,157	7,596,893

T'l surplus	$8,211,230	$17,459,252	$13,754,151
Reserves	....	9,500,000	....
P. & L. balance	$8,211,236	$7,959,252	$13,754,157

The common stock shows an increase from $32,097,700 in 1918 to $37,100,000 in 1919, and the balance available for common stock dividends amounted to 7.1 per cent on the old capitalization, and 6.15 per cent on the increased common stock liability, the six per cent dividend being earned by a narrow margin.

Reference is made to the sale of 50,000 shares of common stock to British interests, as follows:—"During the year an offer was made by a syndicate of British capitalists to purchase on favorable terms 50,000 ordinary shares of the capital stock of the corporation which had been allotted to the Dominion Iron and Steel Company, Limited, which the directors of that company considered advisable to accept. The proceeds of this sale will furnish a part of the funds required to cover expenditures on its property undertaken and in prospect. The instalments payable under the agreement providing for this new capital have been received; the balance is included in accounts receivable under the heading of current and working assets. The discount on these shares has been written off general reserve, reducing the balance in this account to $10,000,000."

In connection with the mooted entrance of Dominion Steel Corporation into a holding company incorporated in Nova Scotia as "British Empire Steel Corporation," the President, Mr. Roy M. Wolvin, states: "Your directors are carefully considering the proposals, and if they are approved, will submit them for your consideration at a special meeting to be called for the purpose."

The Balance Sheet for 1918 and 1919 compares as follows:

	1919.	1918.
Assets:		
Properties	$79,861,902	$75,509,711
Trustees account	145,752	142,432
Current:		
Inventories	9,490,369	9,314,602
Accounts receivable	6,737,807	5,039,479
Cash	1,674,668	3,603,542
Prepayments	....	585,812
Interest, etc.	....	1,715,034
Sale of common stock	1,732,530	....
Employes' Balances	196,155	....
Investments	2,222,037	....
Total current	$22,053,566	$20,258,469
Total assets	$102,645,205	$95,910,612
Liabilities:		
Funded Debt	$20,450,683	$20,830,097
Reserves	2,074,449	2,656,742
Pref. Stock	7,000,000	7,000,000
Do. other companies	8,000,000	8,000,000
Common stock	37,100,000	32,097,700
Special reserves	....	11,500,000
Common stock	37,100,000	32,097,700
Deferred payments	208,000	234,000
Surplus	8,211,237	7,959,252
*Gen. Reserve	10,000,000	....
Current:		
Accounts payable	3,881,634	4,827,930
Accruals	230,378	235,925
Bank loans, etc.	4,844,860	....
Dividends payable	643,966	568,966
Total current	$9,600,837	$5,632,821
Total liabilities	$102,645,205	$95,910,612

* After deducting difference between par and proceeds of 50,000 shares of corporation common stock.

PROPERLY DOMICILED.

There is considerable press comment over the fact that the British Empire Steel Corporation has been incorporated under the Nova Scotia Joint Stock Companies Act, and that its head office is to be at Sydney. There should be nothing surprising in the circumstance that the big Corporation is to be domiciled here. "Where a man's treasure is, there his heart is also."—Sydney "Post".

BRITISH COLUMBIA HAS DEFINITE POLICY TO ENCOURAGE IRON AND STEEL INDUSTRY.

Ore Areas to be Examined and Reservations Effected.

F. J. Crossland, mining engineer of Vancouver, B.C., has been appointed to make a thorough inspection of the hematite and limonite deposits of the Whitewater River section of the Clinton Mining Division. Hon. Wm. Sloan, Minister of Mines, has commissioned him to ascertain, as far as possible in one seasons work the tonnage of this mineral available.

In an address before the last section of the Legislative Assembly Mr. Sloan spoke of a report received from Wm. M. Brewer, Government Mining Engineer, on these deposits which estimated that they afford a possible 50,000,000 ton reserve of limonite of good quality, eminently suitable for fluxing with the magnetic ores of the coast in the production of pig iron by blast furnace, and so situated as to be easily recovered. The Minister then stated that it was his intention to have the district well explored and Mr. Crossland's engagement is in this line with that undertaking.

This Provincial Government work is to be supplemented by the Geological Survey Branch, Ottawa, which will have two parties in the field. One, under J. D. McKenzie will make a geological survey of the Taseko (Whitewater) Lake area and the other, under C. H. Freeman, will conduct a topographical survey.

Notice has been given, also, that a reserve, as authorized by a recent amendment to the Mineral Act, has been placed on the drainage area of the Taseko (Whitewater) Lake, Chilko Lake, Tauniah, Chilquoit and the Chilko River and Big Creek, Clinton Mining Division. This reserve takes effect on the 1st on June. Claims already recorded will not be interfered with but all open iron showings within the limits defined will be held by the Crown until it is determined how far they will be needed for the encouragement of the industry.

SHIPBUILDING

Sydney Harbor, N.S.
A Transport Convoy

Oil Versus Steam For Small Tugs

By WALTER LAMBERT,
Marine Architect, Montreal.

It is a rather remarkable fact that while the motor tug is a generally accepted factor in European tonnage, and fast coming into favor in the United States, its advent into Canada is still in the future, with Canadian marine interests apparently very apathetic to its many advantages.

It is possible that our war conditions are to some extent responsible for this stand-pat attitude, but there is no question but that post-war conditions, with the high price and scarcity of coal, and the excessive cost of labor and materials in general, emphasize a short sightedness in this regard which from the point of view of economy is inexcusable.

During the past few years, the revival of the wooden ship peculiarly adapted to motor installations, and the advent of the large auxiliary vessel, has provided an excellent opportunity to test the capabilities of this type of motor power, and it has shown up well almost without exception. There is one European firm of repute, Messrs. Baumeister and Wain, of Copenhagen, which has orders for ships booked up ahead, sufficiently to keep them busy to capacity for 10 years, in which all propulsive machinery are oil engine installations.

If this type of machinery is for full powered or auxiliary ships, there is little question but that it should especially appeal to the tug owner for it is this class of floating equipment that the great advantages of the oil engine applies in a peculiar degree.

The available engines may be classified generally as follows, according to the grade of fuel they use:—

1st. Gasoline.
2nd. Kerosene.
3rd. Heavy or fuel oil.

of these the first may be practically eliminated except in a few instances when a low powered installation is required, and for only occasional use. Its chief recommendations are low first cost and light weight, but the price of gasoline, now and contemplated renders it commercially impracticable of adoption in competition with engines using a cheaper grade of fuel. It may also be stated that gasoline engines, as a class are not built to withstand the continuous heavy usage usually meted out to commercial installations.

The kerosene engine has been a very popular one for small commercial installations and light draft tugs in other countries. It possesses all the advantages of the gasoline engines, while the disadvantages are in a lesser degree, the fuel is somewhat cheaper and the engine more robust in its proportions, it having been developed principally for commercial usage. For small installations and for light draft vessels it is quite satisfactory from the point of view of economy and service, but for tugs of fair power, an engine using a still cheaper grade of fuel is desirable.

It may here be remarked that the term crude oil is sometimes applied to oil used by diesel and semi-diesel engines, but is somewhat of a misnomer, in that crude oil is properly speaking, the oil as produced from the wells before gasolene and other light oils are extracted from it. Whereas the oil here referred to is the residue after extraction of the lighter oils. "Heavy oil" is a more correct term, but the preferable nomenclature is "Fuel oil."

The semi-diesel or hot bulb engine originated in Holland some twenty years ago, and has been built in small powers in increasing numbers by Dutch and Scandinavian firms principally. It is only of recent years, however, that they have been installed in large powers and have fully demonstrated their economy, simplicity and reliability, qualities which are responsible for the fact that there are today more of these engines in service in the fishing fleets of Europe than of any other type.

With the present price of coal, gasoline and kerosene, the qualities of the fuel oil engine will surely only require to be demonstrated to secure general adoption for tow boat work, particularly as the facilities for obtaining fuel oil have been widely extended during the past few years.

Tug boat service is possibly the most trying to which any marine engine can be subjected, and to this is no doubt due a great deal of the reluctance in the acceptance of a radical departure of the type indicated. The steam outfit is thoroughly and instantly reliable and is in no way "delicate," while the early examples of oil or gas engine failed particularly in this respect. Another essential requirement for the tug is a quick, reliable, and full powered reverse action, and it is only of recent years that this condition has been fully obtained in semi-diesel engines of considerable power. Another drawback has been the difficulty of securing an adequate substitute for steam power as supplied to the windlass and the steering gear.

A cursory inspection of the accompanying design will, however, demonstrate many advantages possessed by the oil-engined tug. The boiler is altogether

eliminated, while the engine is smaller than the steam engine of equal power. The fuel is of greater value, bulk for bulk, can be stowed much more easily, and in parts of the vessels structure not accessible to coal. The saving in weight and space is such that the hull dimensions may be considerably reduced over those necessary for a steam powered hull. This without impairing the capacity of the tug, but rather rendering her more easy to handle and giving her more pulling power. The small tug illustrated for instance, is about equal in power and capacity to the average 55 or 60 foot steam tug, so that there is accordingly a saving in initial cost of both hull and machinery. It is also possible to transport this vessel by rail to an inland lake much more easily than a steam tug of equal power. This is a transportation condition often met with in practice in the design of small tugs.

It is obvious that the fireman's services are dispensed with, together with any accommodation otherwise required for him. It is no longer necessary to bank fires while tug is lying idle, or to use fuel an instant longer than power is required. The absence of the boiler removes a large item against deterioration and upkeep. A coal and steam installation of this power would require a fuel expenditure of $25 per day while the fuel oil required for the motor for a full 24 day run would be only 120 gallons at say 10 cents per gallon equals $12.

The oil engine renders the tug man's life less laborious, and perhaps, the period of industry for older men.

The following is a tabulated statement prepared some years ago, demonstrating the actual saving involved in an oil engined tug over a steam tug, oil fired, both of 160 h.p. Present conditions favour the oil engine in a still greater degree.

Initial Cost.

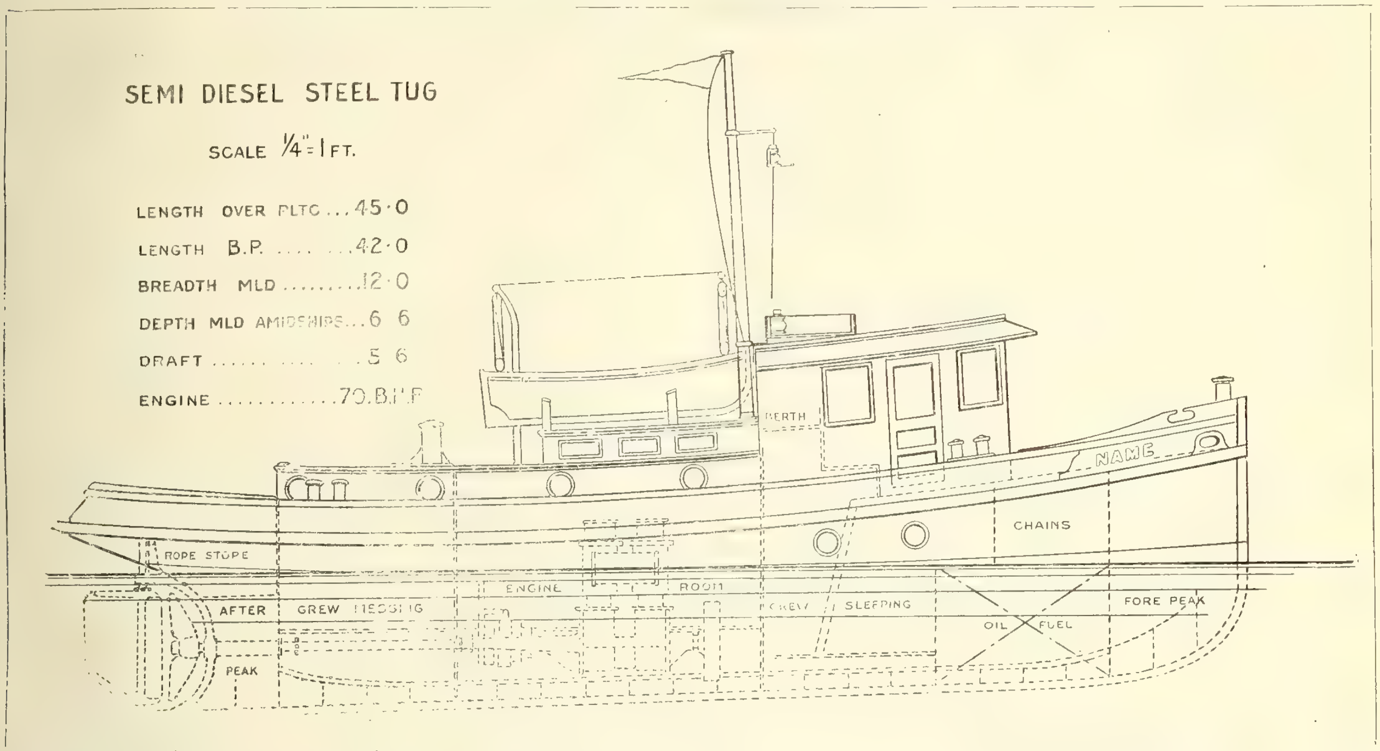
	Steam Engine	Oil Engine
Weight per Horse Power	450 lbs	170 lbs
Cost of Machinery Installed	$13,000	$11,500

Running Expenses Per Month.	**Fuel**	**Ten Hours Day.**
Cost of 30 days fuel	$240	$83.10
Cost of engine repairs	30	15.00
Cost of boiler	20	15.00
Engineers wages	125	125.00
Fireman's wages	65	...
Total	430	208.10

This shows a gain of

Weight	165 per cent.
Initial cost	13 per cent.
Running costs	107 per cent.

The following extracts from the log of the initial voyage of the M.S. "Alca," from Liverpool to Las Palmas are interesting as indicating the dependability of the semi-diesel type of motor. This vessel was fitted with a 90 B.H.P. Krombout engine,and the run described took place five fears ago, since when further developments and improvements have been made.



There is one point in this log which is worth mentioning, and that is, the first day out is the only day on which there was any irregular running of the engine and this is accounted for by the fact that the engineers were down with seasickness.

EXTRACTS FROM LOG OF M.S. "ALCA" ON

Extracts from Log of M.S. "Alca" on voyage from Liverpool to Las Palmas, December, 1914.

Main Engine Run Continuously:—December 16th, 7 hours; December 17th, 13¼ hours; December 18th, 14 hours; December 19th, 20th, 21st to noon 22nd, 98½ hours non-stop run.

Engine were stopped on 22nd for inspection ignition plates and injection nozzles. These found in good order.

22nd (from noon), 23rd, 24th, and 25th, engines ran continuously, developing full power, until came to anchor on 25th in Corcubion Harbour, making a run of 165½ hours, with one hour stop for inspection, before noted.

Equally good performances was noted on the voyage to Las Palmas from Corcubion, engines running without stop from January 8th to January 15th when Las Palmas was reached.

Consumption of oil during whole of trip from Liverpool to Las Palmas was:

Fuel oil, approximately, 1,527 gallons: Lubricating oil, 122 gallons.

From Corcubion to Las Palmas completed a non-stop run with main engines to Las Palmas taking 167 hours.

J. COUGHLAN AND SONS LAY KEEL OF 8,800 TON FREIGHTER

This well-known firm of Vancouver shipbuilders announces that during the first week in June the keel of the fourth steel steamer of 8,800 tons will be laid at the False Creek shipyards. This will be Hull No. 18 in the Coughlan programme, and is being built to the Company's own orders. It will be owned by a subsidiary company, Vancouver Steamships, Ltd.

The fact that the contract for two more 8,300-ton steel steamers for the Canadian Government merchant marine had been signed recently is confirmed by Mr. Coughlan. These steamers will be duplicates of the Government freighters previously built by the company, and construction will begin on the arrival of steel supplies. The vessels will be built to British Corporation rules.

Mr. Coughlan confirmed the report of the sale of hull No. 16, of a similar type to the S.S. "Margaret Coughlan," to Swedish interests.

CANADIAN TRADE COMMISSIONER AT MELBOURNE ON POSSIBILITIES OF CANADIAN SHIPBUILDING FOR AUSTRALIA.

In response to a query as to the possible sale in the Antipodes of Canadian-built shipping, Mr. D. H. Ross, Canadian Trade Commissioner at Melbourne, writes:

"It is stated that the Commonwealth Government costs for building steamers in Australia of about 5,000 tons deadweight—after allowing for interest, etc., upon the yards and all overhead charges—are in the neighborhood of £30 per ton, which at the Canadian par of sterling exchange is equivalent to £146 per ton. At such rates it is possible that, if Canadian builders are in a position to give a fairly speedy delivery, some business may be done. However, nothing but personal interviews, supported by blueprints and photographs and all details, would land the business: and even then there is an element of doubt, as almost all shipping men look for a gradual reduction not only in ocean freights but also in the cost of marine tonnage."

DAVIE SHIPBUILDING COMPANY TO ENLARGE OPERATIONS.

It is announced that the Davie Shipbuilding Co., of Levis, one of the constituent companies of the mooted British Empire Steel Corporation, is planning the erection of shops at Lauzon, Que., for the fabrication of parts for steel ships.

SHIP BUILT ON CLYDE RECEIVES SHAFTING FROM CANADA.

London May 15 (by mail).—The Daily Mail trade commissioner states that the Clyde, the Scottish shipbuilding centre, has had the unique experience of receiving from Canada a complete set of engine shafting for a ship built on the river. So great is the difficulty of obtaining from home sources enough forgings and casting that all kinds of engineering firms are obliged to import these articles from abroad to keep their works going: Many are obtaining from Holland castings in large consignments. Until the shipment of Canadian shafting arrived only materials for hull construction had been brought across the Atlantic.

Before the war, adds the Mail, continental forgings were "dumped" in the United Kingdom at prices with which home concerns could not successfully compete. As a result of the war, it was hoped that our forgings plants would get a new lease of life, but the revival of forging has not been nearly so considerable as was expected.

CANADIAN VICKERS LAUNCH S. S. "LOCH TAY".

The "Loch Tay" a sister ship to the "Tatjana" was launched at the Canadian Vickers Yards at Maisonneuve, Que., on the 22nd May, and will be ready for cargo before the end of June. The vessel is 413 ft. long, beam 52 ft., and 32 ft. deep. Cargo capacity is 8,300 tons on a draft of 25.3 ft. Ship is fitted with triple expansion engines designed for coal or oil firing, and like the "Tatjana," provision is made for storage of 1,500 tons of fuel oil in the double bottom and in the midships oil-tank.

The accessories of the vessel, including winches, steam steering-gear, etc., were all made by Canadian Vickers at Maisonneuve.

The "Loch Tay" is named after a former ship belonging to the same owner, namely Alf. Monsen of Toensberg, Norway, which was torpedoed by the Germans during the war. Capt. Andersen, under whose supervision the vessel was built, was master of the old "Loch Tay" and will take charge of the newly launched vessel.

Two other vessels are on the stocks, one of which, built to the order of the Canadian Government, will be launched towards the end of June. Another vessel, also for Norwegian interests, has the keel laid.

Re-heating Furnaces, Dominion Steel Company's Ship-plate Mill

now set for ships up to 65 feet in breadth, but they can be shifted sideways on the joists so as to admit ships 80 feet broad by sacrificing adjoining berths to a corresponding extent. But it is evident that it would only be in case of a very tempting contract or of urgent necessity that one would thus shift the cranes, for the fore and aft wire stay ground attachments and the railway situated between the berths would necessarily also have to be moved. But, in any case, with this system of cranes shifting the cranes sideways can be done, if necessary, and almost as easily as with the ordinary solitary mast and derrick arrangement.

The cranes can, naturally, be placed as close together as one may like in the direction of the length of the ship—for instance, as close together as ordinary masts and derricks are generally placed, and the crane arms can, of course, within reasonable limits, be made as long or as short as one might fancy, either overlapping each other or not. All this is a matter of taste or requirement.

It is perhaps, then, not inappropriate finally to point out that the present crane design is very elastic—that is to say, the dimensions and capabilities of the crane can be varied within considerable limits, such as in regard to lifting power, length of arm, distance between crane legs, etc., without loss of any features inherent in the design of the crane.

Regarding the saving of labour cost and increased rapidity of building due to these cranes, I regret to say that I cannot as yet speak authoritatively on that point, simply because the cranes have not so far, from want of insufficient supply of steel material during the war and after, been fully tested.

Weights and Cost.

Each crane, including one complete frame and two arms, but excluding winches and hoisting wire, weighs about 33 tons.

As regards the cost, it is fairly evident that these cranes are cheaper than any other existing hoisting appliance with the exception of the ordinary mast and derrick arrangement. They are, however, considered to have special advantages over the latter arrangement which should repay the extra outlay for them.

Regarding the actual cost of the Lindholmen cranes, eight of them, including 8 derrick frames, 16 derrick arms, 16 winches, the necessary hoisting wire, stays, blocks, foundations etc., erected all complete, cost about £11,500—i.e., something less than £1,500 for each double-crane—but as this figure is a pre-war figure it is to-day of comparatively little value.

Reflections.

I hold the firm belief that to build rapidly, a ship should be simultaneously attacked from as many points as possible, and chiefly from the sides, and not wholly from the upper end. Congestion of traffic

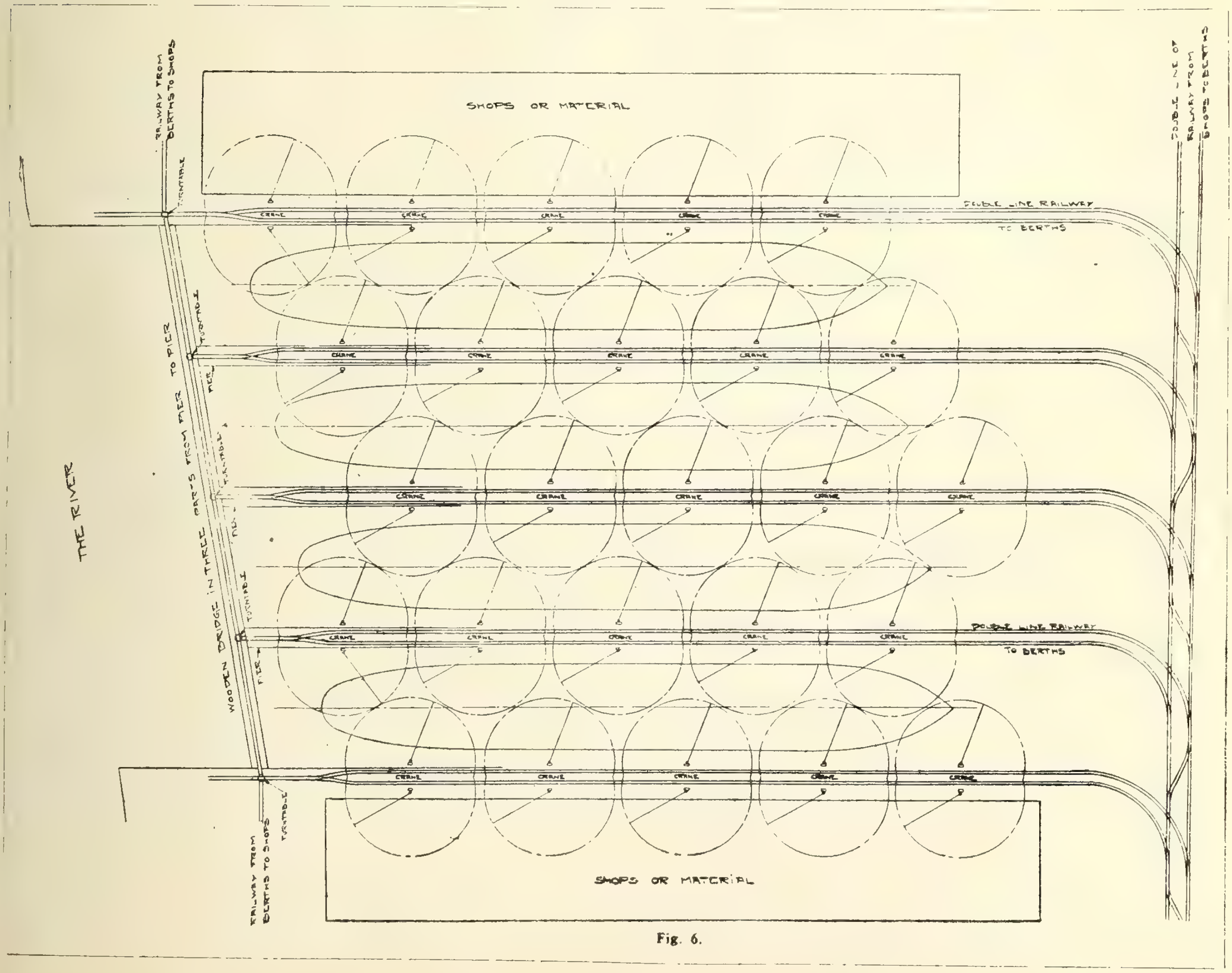


Fig. 6.

must ensue in the latter case, whereas in the former it is essential that a clear passage-way be arranged between adjoining ships through which the material can be easily transported to its proper place at the side of the ship. See Figs. 1 and 6. The material should be transported on light trucks, running on rails, down this passageway to its respective crane hook, and the empty truck should be immediately moved on and returned to the sheds a different way from which it came, as shown in Figs. 2 and 6, so as to prevent the railway line being blocked and the circulation of traffic impeded. For this transporting work I prefer the light truck to the heavy, cumbersome steam locomotive-crane, partly because the number is practically unlimited in a yard, and partly because it is easily thrown off the line if it is in the way, which summary procedure cannot be adopted in the case of the latter. And, after all, the men should be doing something in the meantime, and not merely be hanging about doing nothing, while a solitary steam crane—or a couple of them—at a very slow pace brings forward material to the building berths.

I believe that a double railway line, Fig. 6, between adjoining building berths is preferable to a single line, for fairly often the traffic is impeded if the line is single(, with a consequent loss of valuable time. It is therefore advisable to make the distance between the frame legs of the cranes sufficiently great for eventually admitting a double railway line between them, which can easily be done by fixing the clear distance between the legs to nothing less than, say, 15 feet, for instance.

For what it is worth, I present a schematic outline of a building yard laid out according to these ideas.

BOOK REVIEW

PROSPECTOR'S FIELD BOOK AND GUIDE. By H. S. Osborn. Revised and enlarged by Mr. W. Von Bernewitz. Ninth Edition. 4⅝ by 7⅛ ins. 400 pages. Flexible Fabrikoid backs, designed for pocket use. Price $3.00. Henry Carey Baird & Company, 2 West 45th Street, New York.

This volume is completely reset and revised edition of the issue of 1910. The information regarding ore occurences outside of the United States is fuller and more correct than is often the case in New York publications and Canadian referencs, paricularly in the new chapter on alloy minirals, are reasonably accurate. The chapter on petroleum, asphalt and oil-shales contains much information in condensed space.

The introduction to the work gives preparatory instruction in elementary geology, the use of the blowpipe ore analysis and surveying, and the work emphasises that "the search for ore deposits is becoming a specialized profession, and those that keep this fact "in mind are the ones most likely to benefit by it."

The book appears to be well worth the price asked. It is well bound and adapted for pocket use. The condensed account of ore occurrences throughout the world constitute one of the most valuable features of this book.

The revisor has had practical mining experience in New Zealand, Australia, Dutch East Indies and America, and, judging from the Canadian references, his facts are reliable.

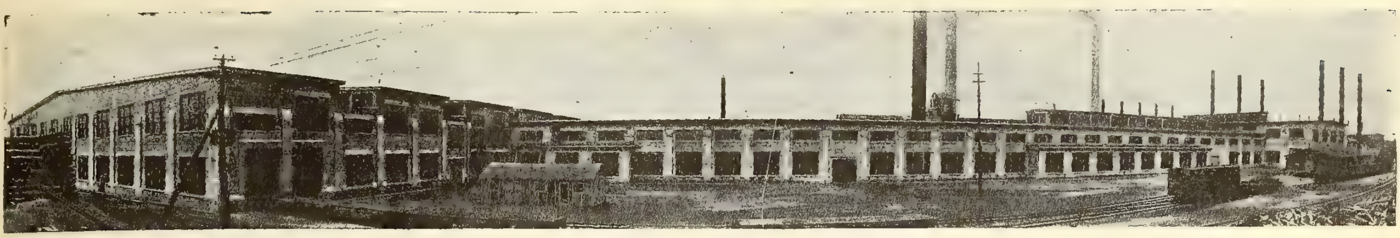


Plate Mill Dominion Steel Corp.

EDITORIAL

The Possibility of Creating an Iron and Steel Industry in the Canadian West

"Iron and Steel of Canada" has followed with sympathetic interest the proposals mooted from time to time for the establishment of an iron-smelting and steel plant in British Columbia. The Provincial Government has made definite public announcement of its intention to assist, and if necessary, initiate the establishment of such a works in the Province. It has taken measures to reserve the iron-ore deposits with this end in view, and, in addition, has for some time held open an offer of a substantial bounty on pig iron produced from ore mined in the Province. Such a policy is in every regard praiseworthy, always provided the local market for iron and steel products warrants the erection of an iron-works and steel-making furnaces, but, considering the trend of labor politics on the Pacific Slope, and the urgent social questions that would arise out of the establishment of a government owned and operated establishment, the ability, or wisdom, of any popularly elected government to carry out the announced intention to build and operate a plant has aroused doubts in those who have first-hand knowledge of steel works operation.

There are two natural ways in which the steel industry could become established in British Columbia. The first is that a successful foundry or metal-working concern in the Province, finding its products in demand, might add open-hearth furnaces to its equipment, importing the pig-iron or using scrap; or might use the electric furnaces to produce steel, provided electric current could be obtained at a low rate. Such a development could take place on the mainland, and, because it would be a gradual evolution fostered by actual demand, it would prove, judging from similar evolutions elsewhere in Canada, permanently successful.

The other possible development is the establishment of an ordinary blast-furnace and open-hearth plant on Vancouver Island, using coke and gas as near as practicable to the point of origin of the coal, bringing the ore and fluxes to the coal.

It is, therefore, encouraging to know that the Canadian Collieries (Dunsmuir) is seriously examining the possibility of utilising its resources on Vancouver Island, which includes coking coal, iron-ores, fluxes, and hydro-electric powers, combined with an existing business organization and technical staff and the choice of suitable maritime locations for a plant and point of assemblage. In commenting on this matter in a previous issue the necessary combination for a successful iron and steel industry was assumed to be "Iron and steel manufacture, associated with steel-"shipbuilding, both based on large reserves of coal, "iron-ore and fluxes, having a suitable maritime lo-"cation". The Canadian Collieries Limited possesses this combination of pre-requisites in larger measure than any other corporation on the Pacific Slope.

The Chairman of Canadian Collieries, Mr. H. S. Fleming, very properly points out that before commencement of the large expenditure that the creation of an operating iron and steel plant would require, it is necessary to have definite assurance of a minimum local market for the product of the plant, together with guarantees that the legislation of the future will not impose impossible conditions regarding working hours and taxation.

The proposal which is also made at this time to establish a steel plant at Seattle, which would compete with any plant in British Columbia, will doubtless stimulate interest in the last-named province, and, while it may well be that the financial resources available in Seattle may be greater and more readily obtained than will be the case in British Columbia, the State of Washington is not provided with metallurgical coal as is Vancouver Island, and the ore supply for a Seattle plant would—to some extent at least—come from Texada Island. The advantage certainly lies with British Columbia so far as possession of the necessary raw materials is concerned, and, in the matter of location, Vancouver Island has a great many things to be said in its favor.

The likelihood that the future of steel-shipbuilding in British Columbia depends on the local manufacture of steel and steel products, and the saving of heavy transportation charges from eastern points, is another incentive to interest at this time, in view of the possibility that some of the shipyards now operating on the Coast may shortly have to close down.

IRON OCCURRENCES IN ALBERTA.

The Government of Alberta has recently published the first of a series of annual reports upon the mineral resources of that province, compiled for the Mines Branch by Prof. John A. Allan, of the Department of Geology in the University of Alberta. The appearance of this Report is in many ways significant, and in all probability forecasts the enlargement of the work of the Mines Branch, which hitherto has been largely confined in its scope to oversight of the coal-mining industry.

The Report includes the most detailed and accurate account of the iron-ore occurrences of Alberta yet published, and it is well that the work has been done so carefully and without any attempt to gloss over the meagre character of the iron-bearing rocks occurring in Alberta, so far as they are known. Moderate hopes, based on ascertained fact, are much better than glowing optimism without real foundation. Iron-ore is of all industrial raw materials one dependent for its value on relative factors of accessibility and the presence of bituminous coal in its vicinity. The iron content of an ore becomes a matter of secondary importance if the ore occurs near large deposits of coal adapted to use in metallurgical processes. The presence of clay ironstones—although not reported in commercially available quantity and occurrence—is suggestive, as the proximity of coking coal enabled the clay ironstones of the north of England to be largely and successfully used before richer ores were imported from abroad. It is well that Prof. Allan should have so clearly exposed the inaccuracy of the newspaper reports upon the existence of "billions of tons of iron ore" in the Sheep River section, where, after careful search, he reports that not a single ton of rock is exposed in this district that could be classed as iron ore, thus confirming the accuracy of omission of mention of iron ores in this vicinity by the Geological Survey.

It is a well established fact that the presence of coal deposits in time bring about the transportation of the ore to the coalfield and the establishment of metallurgical industries, and therefore, as Prof. Allan remarks, the presence of iron ore of even a moderate grade is important in Alberta, or in the bordering provinces, and the existence of large unprospected areas in the northern portions of Alberta and Saskatchewan suggests that it is yet too soon to conclude that the presence of 87 percent of the coal reserves of Canada within the boundaries of Alberta will not bring about that historical evolution of iron and steel manufacture of which so many examples could be cited in other coalfields.

It is obvious, from a perusal of Prof. Allan's report, that the knowledge of the mineral resources of northern portion of the prairies provinces is as yet meagre and disconnected.

It is also discernible, from the publication of this Report, that Alberta is about to experience that development of mining activity that follows extensive agricultural settlement and the creation of urban populations with capital accumulations that must precede industrial activities. This is not only a hopeful sign for the West, but it is a development that will in time correct the single vision of the people of the West and bring it to view with more understanding and sympathy the industrial development of the East. The admixture of manufacturing and mining industries with the hitherto dominant interests of agriculture will prove a salutary corrective of viewpoint and will do more to consolidate Canadian opinion than much discussion of fiscal politics.

BRITISH EMPIRE STEEL CORPORATION.

The consolidation of the coal-mining, steel-making and shipbuilding activities of Nova Scotia, with inland water transportation companies and steel-ship building plants serving the central provinces of Canada has proceeded to a point where fulfillment of the plan outlined seems probable. There has been some disagreement upon financial details, and there may be further modifications of a book-keeping character before the balance-sheet of the unified companies assumes its final shape. As to these we have no comment to make, believing that the technical operation of the coal and iron-ore properties provides a sufficiently compelling reason for the proposed consolidation, and one that is within the province of a technical journal to discuss.

The statement issued by the President of the Dominion Steel Corporation to the shareholders asking ratification of the agreement with the British Empire Steel Corporation recommended by the Board—and previously approved and ratified by the Board and shareholders of the Nova Scotia Steel and Coal Company—bases recommendation of consolidation upon correct and proper grounds, to wit:

"The improvements made to your properties during "the past four or five years have been very extensive "and are of the most modern character, but further "important renewals and improvements are necessary "to increase output and ensure continuously profitable "operation. These will necessitate the expenditure "of large sums of money which the Company has "not at its command, and which must be provided "through some form of capital financing........ The "operations of the Dominion Steel Corporation and "of the Nova Scotia Steel and Coal Company, being "carried out to a large extent contiguously, have re-"sulted in much duplication of capital expenditure, "and to extend the operations of these companies "separately, to a degree commensurate with their pos-"sibilities would of necessity entail further duplication, "and on a scale much greater than has taken place "in the past."

This is equivalent to stating that under separate operation the properties of the two companies mentioned cannot be extended to a degree commensurate with their possibilities, an accurate pronouncement, and an all sufficient reason for combined operation.

We believe that operation of the coal and iron-ore properties of the Dominion and Scotia companies in Cape Breton Island and in Bell Island, Newfoundland, will result in the maximum extraction of mineral, over the maximum period of time, at the minimum cost of production, a consummation devoutly to be desired, and to be had in no other way.

The effect of consolidation from the commercial side is accurately and felicitously phrased in the statement that "The various inter-related activities of "the different companies heretofore separately man- "aged, must tend, when operating jointly, towards a "more uniformly profitable operation as a whole, and "to less fluctuations in earnings." An identical statement was made by the President of Scotia in a circular to the shareholders of that company.

Ratification of the consolidation is in several places in the Dominion Steel Corporation circular emphasised as being contingent upon fulfillment of the clause in the agreement with the promoters which guarantees the provision of twenty five million dollars of new capital, of which it is interesting to note from recent statements in the newspapers, twenty million dollars is ear-marked for expenditure on the enlargement of the coal and steel operations in Nova Scotia. It is not likely that this capital expenditure, large though it may seem, will meet the full necessities of the properties for more than a limited period of the future, but it is well to know that the expenditure will be made in the joint interest of the consolidated properties and will not be dissipated on parallel, contiguous and competitive development.

We would again suggest that to ensure the fullest revenue from the properties and plants, and the maximum of security against trade fluctuations, that the requisite proportion of the capital expenditure contemplated should be made at the coal mines.

Mr. Wolvin in his statement truthfully says: "Coal "and ore are of no value unless developed, and it is "felt that these two companies as partners in the "ownership of such large resources are under oblig- "ation to further develop them in the national interest "and for the common good." It is unfortunately only too true that if coal resources are of value only in proportion to their development (and the statement is unassailable) then the coal resources of Nova Scotia are thirty percent less valuable than they were in 1914. Realisation of this condition of affairs, and provision of the necessary capital for development, are among the most hopeful signs of the times in regard to the coal industry of Nova Scotia, but they have been a long time coming.

GOVERNMENT AID TO SHIPBUILDING.

The belief expressed in our last issue that the Canadian Government would give careful consideration to the shipbuilding industry, has been confirmed by the approval by Parliament of the proposal of the Minister of Finance to endorse promissory notes drawn by the purchaser, the Government protecting itself by a mortgage on the vessels built under the arrangement. The shipbuilding industry in Canada, if judiciously fostered at this time, bids fair to become a permanent source of national revenue and employment, and in years to come, the action of the Government, first in building and operating its own mercantile marine, and now by lending the country's credit to stabilize the young industry and carry it over a difficult period of growth, will be looked back to as a wise and statesmanlike policy.

Prof. Sir John Cadman, in his Presidential Address before the Institution of Mining Engineers given in London recently, told his hearers that there are two things by which the material strength of a nation may be gauged, namely, the tonnage of coal production and the tonnage of shipping owned in the country. The Government's solicitude for the country's mercantile marine is therefore a hopeful sign of the times, and the presence in the Dominion of Canada of the second largest coal reserve in the world provides a substantial basis for hope that in respect to coal production Canada will some day take the rank as a coal producer that it is her right and duty to take. We would point out that shipping is necessary to coal production in Canada.

"STELLITE" CUTLERY TO BE MADE AT DELORO, ONTARIO.

The significance of a new industrial development does not necessarily reside in its magnitude, and the initiation of the manufacture of "stellite" cutlery by the Deloro Smelting and Refining Company, at Deloro, Ontario, is more important than the number of workman or the capital expenditure presently involved might indicate considered alone. "Stellite" cutlery is a unique product. Although the alloy is one that has been developed in the United States, it depends primarily on Canadian ores for the metals which enter into its composition, and Canada is intimately interested in the extension of the uses to which the alloy is being put. The "stellite" knife offers to the user a blade that will not rust and is permanently provided with a keen cutting edge that requires no sharpening, and its adaptibility to domestic uses is apparent.

While cutlery manufactured from this wonderful alloy has peculiar merits which should secure it a ready market, we believe there exists an opportunity in Canada also for the development of a cutlery industry using ordinary materials. Sheffield is over-

whelmed with cutlery orders and will be a long time before it can supply trans-Atlantic markets. The steady growth of cutlery manufacture in New England suggests that a similar development is possible in Canada. There is no secret about cutlery manufacture as many have supposed, and, as previously pointed out in these columns, and as confirmed by the Deloro Company's new enterprise, we have in Canada all the materials that are necessary for cutlery manufacture.

Of interest in this connection is the proposal to commence the manufacture of pocket knives in Kingston, Ontario.

THE UNIONIZATION OF TECHNICAL MEN.

The letter from the Secretary of the British Columbia Technical Association, contained in this issue, will be interpreted according to the mentality, the economic training and the corporate affiliations of the reader, but its significant feature is that unionization of technical men is an accomplished fact in one province of Canada. The reference in the concluding paragraph to a "Canadian Technical Association" is probably prophetic in the sense of being an intelligent anticipation of coming events.

The meat of the letter is the clear-cut statement: "The primary object of this Association is the protec- "tion and advancement of the material welfare of "its members." It fell to Dr. Turnbull's lot at the Vancouver Meeting of the Canadian Mining Institute to acquaint that gathering with the aims of the newly formed Association, and in doing so he emphasised service as the primary object. He stated that the Association did not want to adopt the trade union method of forcing concessions if they could be obtained in any other way. Between service to others and self-interest Dr. Turnbull suggested a midway path could be found, and concluded by advising those technical men who did not agree with the aims of the Association to "come in, and make it suit you." It is just as well to avoid ambiguity, and as we suggested in this column some months ago, while the British Columbia Association began by making "service" the keynote of its policies, it is useless to disguise the fact that the genesis of this association, and similar associations in other countries, is the necessity laid upon the technical men either to organize for self-protection, or suffer piecemeal disintegration of all their hopes and ambitions in life.

The increase of the material welfare by any body of men is an understandable aim, much preferable to any claim for consideration based upon public interest. Notwithstanding all the Christian virtues supposed to reside in self-abnegation, it is generally regarded as eminently proper that men should look after their own. It is a viewpoint that all can understand, and the British Columbia Technical Association has done the proper thing to declare its real objects so unmistakably.

At the same time there is much danger in undue emphasis of the statement that the technical workers constitute a "third class," the remainder of the public being composed of Labor and Capital. There is also very much to be said against the attempt to legislate the prescription of the status and practice of technical employment in such wholesale blanket enactments as the draft of the Professional Engineers Act which the British Columbia Technical Association originated and backed in its progress through the Legislature of that Province. Class consciousness is a thing that is very much overdone in these days, and it is a thing foreign to the mentality of the technical worker, who is above all men an individualist and a solitary seeker of untrodden paths. A coercion of the individual, a standardization of thought leading to stagnation and lessened initiative, is an unavoidable accompaniment of class legislation and a too pronounced class consciousness. History abounds with examples of national culture that have declined and died because of the rigid division of the people into guilds, castes, priesthoods and classes. We believe the safeguard against such dangers lies in the emancipated character of the scientific worker's mental processes, and would therefore endorse the recommendation already referred to that technical men should join their own organizations and assist in guiding along proper lines a movement that is already important, and bids fair to become much more influential and widespread.

Science has no bounds. The influence exerted upon mankind by scientific workers will not be in proportion to their mutual organization, but will arise in the future as it has done in the past from the unknown and often obscure investigator who plays very little part in the active life of men and is often careless of material welfare. The impossibility of defining the indefinable will always militate against the formation of technical workers into a bourgeois class, and our intellectual classes will persist as a vivifying, and sometimes disturbing element in our national life

A further responsibility devolves upon those who advocate the unionization of technical workers, namely, that by a process which can be seen in daily operation in Canada, policies may originate which will eliminate from the organization those who enter the ranks of the employer and those daring and ambitious souls who will run their lifecourse untrammelled and scorn direction from any course. Thus such an organization may tend to become mediocre in is composition, and it will devolve upon the leaders to prevent a lowering of professional attainments and the creation of a class that will be midway between the trades unionist and scientific workers of acknowledged eminence, and content to stay there.

CORRESPONDENCE.

The Editor, Iron and Steel of Canada:

Dear Sir,—Acting upon instructions from the Executive Committee of the Provincial Council of the British Columbia Technical Association, I append herewith a brief statement of the history and accomplishments of our organization, with the hope that it may be of some service in inaugurating similar organizations in other provinces of Canada.

The action of the Toronto Branch of the Engineering Institute of Canada in drawing up resolutions which were forwarded to their headquarters, asking that an organization upon similar lines to those of the B.C.T.A. should be formed, is a further reason for our venturing to write to you upon this subject at the present time.

No doubt you are aware of similar movements in Europe, such as the Federation of Professional Workers in Great Britain and also in the United States, such as the American Association of Engineers.

"Labor," by means of "Unions," is forcing up "Wages" for the "Laborer." "Capitalists and Employers" by similar combinations are raising commodity prices. Neither of these two great classes are interested directly in promoting the welfare of the technical worker. Unless some effective force is organized the product depending upon technical effort will continue to be appropriated mainly by the two organized classes. A nation-wide combination of professional workers is the only effective method of asserting that there is a third class whose rights must be properly considered. That the existence of this third class is rapidly receiving prominent recognition is indicated by the discussions that took place in the House of Commons at Ottawa on May 7th last, on the establishment of a National Research Institute in Canada. For example, Mr. Alfred Thompson, Member for Yukon, made the following statement (see House of Commons Debates, May 7th, 1920, p. 2229):

"Canada is rich in mineral resources—immensely rich—but in order to transmute these resources into commodities which the world needs, one thing particularly is required, and that is applied science. Industry you must have — you must have the intelligent artisan you must have people in the country who have faith enough in its future to put their capital into manufacturing enterprises; but without science that labor and those manufacturing enterprises would not go very far." '

The demand for applied scientists and researchers is greater than the supply. What price should be paid for our absolutely essential and primary commodity? Who is to dictate the price? These are questions that we alone can settle.

Many professional and technical organizations exist in Canada. The primary object of these existing organizations is essentially the advancement of knowledge. In February, 1919, a number of technical workers in British Columbia co-operated to form the British Columbia Technical Association. The primary object of this Association is the protection and advancement of the material welfare of its members. At the same time this protection operates to the benefit and service of the public by refusing recognition of the pseudo-technologist.

Our infant organization slightly over a year old has in our numerically small province, already about 500 members, with local branches at Vancouver, Victoria, and Cumberland. The membership consists of Civil, Mechanical Electrical, Chemical and Mining Engineers, Chemists, Geologists, Architects, Naval Architects, University Professors and allied professional workers.

I enclose for your perusal copy of our Constitution, By-laws, list of members((together with our First Annual Report, and would particularly call your attention to the following results of our work:—

(a) List of members to date.

(b) The Professional Engineers' Act of B.C. This Act was based on the Engineering Institute of Canada Model Bill, and was fathered by the Engineers' Joint Legislation Committee. The delegates from the B .C. Technical Association, backed by the organization throughout the province, were very active in working for the passage of the Act.

(c) The Architects' Act of B .C. Our Association was able to give valuable assistance to the Architects Committee in charge of the Bill (a number of whom were members of the B.C. Technical Association).

(d) The Schedule of Minimum Salaries for Civil Engineers.

In addition, special committees have under consideration the preparation of scales of Minimum Fees for Civil Engineers, and also scales of Minimum Fees and Schedules of Minimum Salaries for Mechanical, Electrical, Mining and Chemical Engineers.

Notwithstanding the results already achieved, the Council and Members of our Association feel that our work is circumscribed and that only by the formation of similar organizations in the other provinces and the subsequent federation into a "Canadian Technical Association" can we all obtain the just recognition and dividends that our scientific knowledge and work demand. This will unquestionably react to the advancement of Canada and of our Empire by encouraging more of our youth to choose a scientific career.

We shall be pleased to have you consider our suggestion favourably and to make any enquiries of us that may be of assistance to you and ultimately to our mutual benefit.

Yours faithfully,

R. Snodgrass,

Secretary-Treasurer.

"TRANSPORTATION AND OTHER MATTERS"

"Iron and Steel" is in receipt of a series of 12 blotters issued by the Canadian Car and Foundry Company of Montreal, the feature of which is a series of clever drawings by the Publicity Agent of the Company, Mr. H. W. Hartnell. Not since E. T. Reed drew his delightful series of "Prehistoric Peeps" for "Punch" have we seen a better combination of humour and imagination, and certainly we do not remember to have seen in industrial advertising such an arresting and unusual series. Mr. Hartnell's prophetic drawings of an aerial, gyroscopic, electric trolley-car, and of the possibilities of the railway car, were the unfortunate limitations of the 4 ft. 8½ in. gauge and the ordinary clearances not to be reckoned with, are not only clever drawings, but show a penetrating understanding of railway rolling-stock equipment.

IRON ORES BOUNTIES IN ONTARIO.

Port Arthur.

To the Editor, "Iron and Steel of Canada."

Dear Sir:—In your issue of March there is an editorial on the Iron Bounty question which is being presented again to the Federal Government for consideration.

Special attention is drawn, and rightly to Mr. Mills' expression as to the advisability or necessity for developing our own iron ore deposits.

The Port Arthur Board of Trade has a mining Committee entirely of owners, prospectors, geologists and engineers who have, as far as lay in their power, given very careful consideration to the question of developthe iron ores of Northern Ontario. Up to the present time, however, the Minister of Mines has not met this Board, or as far as I can learn, any member of it to discuss this matter at all. While it was quite true that in an issue of your journal of January 23rd, there was an article stating that a deputation of mining men from the City Council had been invited to meet the Minister of Mines, it was also quite true that this invitation never reached the Mining Committee of the Board of Trade and as far as I have been able to ascertain, there was not a single man in that City Council who has any special knowledge of mining, more particularly the more intricate subject of the development of our iron ranges.

In connection with the conserving of our iron ore reserves as stated by Mr. Mills, why not go further if we wish to take that line of thought and conserve all our coal, go on importing in huge quantities, our nickel deposits, also our pulp-wood areas, and only manufacturing what we need absolutely for our own use. As it takes forty years to grow spruce trees of merchantable size, it can readily be seen our present areas might easily be largely or partially used up before new forests can be brought into service. We have iron-ore reserves in Northern Canada that will fill all demands for probably several thousand years. Many of these ranges are of course inaccessible at the present time, but can always be made available when urgently needed.

The Minister of Mines of Ontario is also much interested in the project of bringing iron ore from the Belcher Islands, Hudson Bay, down to the proposed Terminal of the T. & N. O. Railway, thence over that line to Lake Ports. As this ore is admittedly of low grade, freight charges alone would more than cover the total returns of the ore, leaving nothing for mining costs or any other branch of the work. This project was carefully considered a few years ago by very competent engineers who simply stated that it was economically impossible and the condition now exists that though iron ore prices have increased greatly in the last two years, freight charges and costs of producvtion have also increased in proportion.

In the article taken from the "Iron and Steel," it is stated that those who are requesting a bounty desire it to be paid upon the quantity of pig iron or steel made in Canadian furnaces or mills from domestic ores. **There is absolutely no foundation for such a statement.** A large number of Boards of Trade made representations to the Government asking for a bonus on iron ore to be payable to the operator of the mine, for the principal reason that formerly when bounties were paid on pig iron produced, the operator of the mine received none of this assistance and he is the one who does all the pioneer work, puts up with the fluctuations of iron ore prices, etc., while the smelter received a great amount of assistance from the bonus during the lean periods. This plan was proven to be a failure by the results of the former bonus which was given to pig iron produced, and the fact that the same bounty given recently in British Columbia to smelters has not had the desired effect, the development of the iron ore resources remaining as before.

The Algoma Steel Corporation is in the rather unique position of being mine operator, beneficiator and user of its own beneficiated ore. Last year they produced a beneficiated ore from the Magpie Mines which ran, natural analysis, Iron 49.41 per cent, Phos. .014 per cent, Silicia 8.68 per cent, Mang. 2.72 per cent Lime 7.82 per cent, Sulphur 16 per cent. Loss by ignition none, Moisture 1.72 per cent. This makes a very desirable product, and while it is quite true that individual furnaces might not take a very great tonnage, the same reasons for not doing so would apply to many of the larger producers of straight minerun ore in the United States. The marketing of beneficiated ore should not be any special worry as this is going on quite steadily from different States.

For its own furnaces and mills at Sault Ste. Marie the Algoma Corporation expects this year to use 40 per cent of its beneficiated ores and there will be ample demands in the American markets for any surplus. The granting of a bonus on pig iron would suit this isolated case admirably, but as the greater ore reserves are tributary to the head of the lakes, these would not receive any benefit.

The smelters and steel mills of Eastern Canada have received millions in subsidies, while the production of iron ores for domestic uses has dropped to 4 per cent of the raw material used. As this plan was a complete failure, why not give the bonus to the operator of the iron mine, and get this great import reduced?

The Western Provinces which were the strongest in opposition to the granting of the bonus on iron ores had no hesitation in recommending expenditure of public monies on the development of their coal resources, as is evidenced by the programme now arranged in the Western Provinces for the expenditure of $400,000 in experimental work on the western coal ranges. This sum is divided as follows:—50 per cent paid by the Federal Government and 25 per cent payable by each of the two Western Provinces, Manitoba and Saskatchewan. The principal objection would seem to be the word bonus.

Other writers in different articles have stated that the Government should give a bounty sufficient to pay the beneficiation. Personally, I would not be in favor of such a plan as the cost of the beneficiation varies so much that there would be endless controversies. The mine owners do not want to be guaranteed a profit, but simply assistance to tide over the installation of large plants which could only be planned after extensively and costly experiments on the individual ranges. This would be absolutely necessary as the operation that would suit one selection of ore might be entirely unsuitable for another. To give a bonus on Canadian ores equivalent to cost of beneficiation to places these ores on a parity with straight ore mines, would mean that as soon as the bonus stopped the mines would have to shut down.

Suggestions have been made and it has been broadly hinted that if a bonus is granted at all it will be for $1.00 per ton and for a short term of say, from three to five years. This would suit Moose Mountain and the Magpie Mines, but would be absolutely worthless to any other part of Ontario.

It would take weeks, if not months, to complete negotiations in connection with the acquiring of a range; months for an expert survey of the same; still more months for diamond drilling to ascertain tonnage and get information as to plant needed at least a year to get this plant delivered and erected; another year to get on a reasonable shipping basis, but it would not take many minutes to figure out how much of the short-term bonus one would get. The benefit in figures would be represented by ciphers only.

A bonus of 50 cents per ton on iron ore for a term of fifteen years would have a far greater effect and a much more equitable distribution than a larger grant for a shorter term of years. This bonus should be payable only on production of certificate of sale to smelters or manufacturing agent.

Beneficiation must come and soon. So far as is known there are no large iron ore bodies of commercial grade in any of the provinces, but so little exploraation has been done, and so many miles of favorable structure have been found on the iron ranges that is is quite safe to assume that large bodies of good grade ore will be found, but it may take years to locate these, while it would take but a few months to bring our large deposits of easily accessible low grade material into active service.

The United States operators are turning their attention to this problem more and more every year and in a generation or two, when the larger deposits of marketable grade ores are worked out, they have only to turn to their own almost inexhaustible supplies of lean ores. They will probably never have to call on the Canadian ore reserves for any supply.

The solution of the problem of the iron and steel supply for the west of the Great Lakes and provinces east of the Rocky Mountains would be comparatively easy by following out the same line as was followed in establishing shipyards and dry-docks where **most needed** in the Dominion. Given a similar subsidy for a term of years on actual capital invested, we would see large steel works established where Iron, Coal, Power and Shipping meet, at the Head of the Great Lakes. Enough of a subsidy to give the iron mine operator 50 cents a ton for an equal number of years could easily be arranged and this development could go on at once, as would be absolutely necessary before the establishment of mills and furnaces. The Government would not pay out one dollar unless it was well earned, and the resultant revenue, not only to the Government, but also to the Canadian National Railways which serve 75 per cent of the Iron Ranges of the Canadian Lake Superior Districts, would in itself much more than balance the expenditure. Every agriculturist in the West utilizes from $1,000 to $5,000 worth of steel and iron implements. On every one of these there would be affected a saving from eight to twenty per cent of cost in the freight charges alone by the establishment of such a system, and the tariff critics would be saved much labor and argument.

Your very truly

J. E. MARKS

OBITUARY

Kennet William Blackwell, the late Vice-President of Canadian Steel Foundries, Ltd.

A prominent figure in the steel casting industry of Eastern Canada has passed with the death of Mr. K. W. Blackwell of Montreal.

Mr. Blackwell, son of the late Thomas E. Blackwell, was born in Devizes, Wiltshire, England, nearly seventy years ago, and came to Canada when a youth with his father, who was the first general manager of the Grand Trunk Railway. He was educated at Bishop's College School, Lennoxville, and was apprenticed as a mechanical engineer in the G. T. R. shops, Point St, Charles. He was later appointed mechanical superintendent of the G. T. R. for the division between Montreal and Toronto, with headquarters at Belleville. Subsequently he became mechanical superintendent of the Chicago and Grand Trunk Railway, and later joined the C. P. R. as mechanical superintendent.

In 1882 he went into the manufacturing business under the name of K. W. Blackwell, manufacturing railway car springs, etc. This business latter became a joint stock company of which Mr. Blackwell was president, the firm subsequently becoming Montreal Steel Works, Limited, of which Mr. Blackwell was president and managing director. The company was absorbed by the Canadian Car Company under the name of Canadian Steel Foundries, Limited, Mr. Blackwell being vice-president up till the time of his death.

Mr. Blackwell was vice-president of the Merchants Bank of Canada and a director of several prominent business concerns. He was a past president of the Canadian Society of Civil Engineers, and prominent in engineering circles.

The regard in which Mr. Blackwell was held was shown by the attendance at his funeral of eminent representatives of the steel and railway industries and engineering societies drawn from a very wide radius around Montreal.

A. W. Benjamin of Yarker, Ont.

A well-known manufacturer of Eastern Ontario passed away on May 11th, in the person of A. W. Benjamin, head of the Benjamin Wheel Company, Limited, Yarker, Ont. Mr. Benjamin conducted a wheel and axle factory in Yarker for many years, making most of the wheels used by the McLaughlin Carriage Co. Later, when the latter company went into the automobile business, Mr. Benjamin took up the manufacture of automobile spokes and wheels. Still later he began the manufacture of baskets, boxes and patented shipping containers. His death occurred after a brief illness at the Kingston General Hospital.

ROLLING WIRE RODS FROM FRESH CAST 4-INCH INGOTS.

The Black Steel & Wire Co., Kansas City, makers of steel wire, and wire products, have installed a McLain-Carter open-hearth furnace, the steel from which will be cast into 4, 6,and 8-inch ingots. It is anticipated that the 4-in. ingots, immediately following casting, will be rolled into wire rods, while in red-hot condition without further heating. If the anticipations of the management are fulfilled, they will achieve a distinct advance in the practice of small wire-mills. The open-hearth furnace is rated as a ten-ton unit, but has a maximum capacity of 30,000 lbs., and is guaranteed to melt five heats per twenty-four hours.

Saving a Six Ton Forging

By BERNARD COLLITT, F.I.C., Lincoln, England.

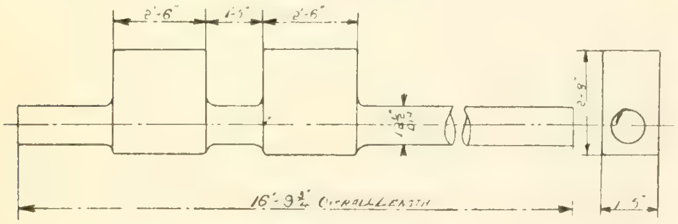
The forging in question was intended for the crankshaft of a twin cylinder horizontal oil engine of 340 B.H.P., and the dimensions of forging as received in the rough state are shown in Fig. 1. The weight was just short of six long tons, say 13,300 lbs., and the largest cross section was approximately 540 sq. inches. The material specified was 0.35 per cent carbon steel of the following composition:—

Carbon—.30 to .40 per cent.
Silicon—Not over .30 per cent.
Manganese—.50 to .85 per cent.
Sulphur—Not over .06 per cent.
Phosphorus—Not over .06 per cent.

and the tensile test required was:—

Maximum Tensile Stress—67,200 to 89,600 lbs. per sq. inch.
Yield Stress Ratio—Not less than 50 per cent.
Elongation—Not less than 25 per cent.
Reduction of Area—Not less than 45 per cent.

The first machining operation on such forgings is the cutting out of a block of metal from between the crank webs, and this gives an excellent opportunity for carrying out tests of the material in the immediate vicinity of the crank pin and webs.



Crankshaft Forging
340 BHP Twin Cylinder Oil Engine

FIG. 1.

In the present case tests were taken as usual in the three directions "A," "B" and "C" as shown in Fig. 2. The test pieces were machined from the block as shown, No. A1 being in a direction parallel with axis of crank pin and from the portion of the block adjacent to the pin, whilst No. A2 was taken in the same direction, but from one of the edges of the block furthest away from the crank pin.

The results of tensile tests are shown in Table I.

TABLE I.

	Yield Stress. Lbs. per sq. in.	Max. Stress. Lbs. per sq. in.	Elongation %.	Reduction of Area %.	Fracture.
Test Piece A1.	35660	73110	26.7	42.1	Fibrous
Do. A2. ...	38930	74770	27.7	45.1	Fibrous
Do. B.	34180	70600	10.3	10.0	30% Woody 70% Crys'ne
Do. C.	29210	58780	14.0	17.8	Crystalline

Inspection of these figures shows that in direction "A" the material was substantially in accordance with the specification, the Yield Ratio and Reduction of Area being only slightly below the required percentages. In direction "B" the Elongation, Reduction of Area, and the character of the fracture showed the steel to be sadly deficient in ductility; whilst in direction "C" it was much below specification in every respect. Systematic testing of several hundred similar forgings of smaller size, however, has demonstrated that tests such as those embodied in the present specification cannot be obtained in direction "C" on account of the difficulty, or impossibility, of applying work to the forging in the endwise direction.

On communicating the test results to the makers of the forging, they frankly gave all information as to its life history up to the time of leaving their works. Their analysis of the steel agreed very well with the figures previously given; the forging was made from a 39-inch fluted octagon ingot weighing 16 tons, so that the reduction on working would be in the neighbourhood of 2¼ times, reckoning from the largest cross section of the ingot to the largest cross section of the forging. The forgemasters requested that two further tests in "B" direction be made, and the desired test pieces having been machined, the tests were carried out in the presence of their representative. Results of these re-tests are given in Table II.

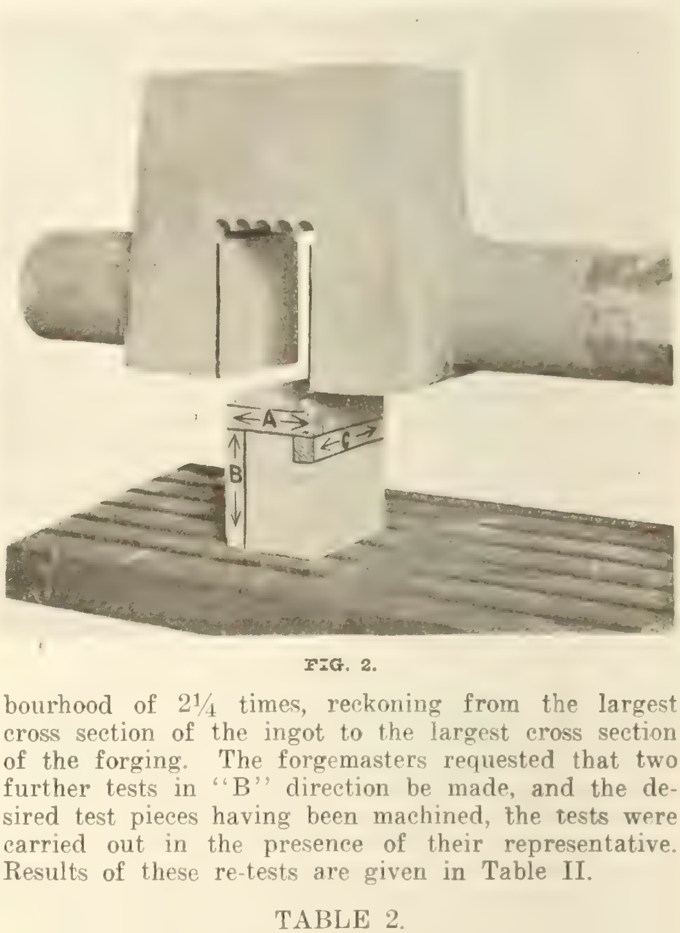


FIG. 2.

TABLE 2.

	Yield Stress. Lbs. per sq. in	Max. Stress. Lbs. per sq. in	Elongation %.	Reduction of Area %.	Fracture
Test Pieces B4.	34720	67600	12.5	11.4	20% Woody. 80% Crystalline
Test Piece B5.	34670	68000	10.0	9.5	5% Woody, 95% Crystalline

It was realized by both the forgemasters and the purchasers that the steel was in a condition that for-

bade putting it into service, as the most important component of an internal combustion engine. It was therefore decided to have the forging oil-quenched and tempered, and to ascertain what improvement could actually be effected by such treatment. The blocks of metal which had been removed from between the webs of the two cranks were secured as nearly as possible in their original positions by means of steel straps and bolts, so that they would receive precisely the same treatment as the whole forging. After the oil-quenching and tempering, the block from which the six test pieces A1, A2, B, C, B4 and B5 had been machined was liberated from the shaft, and test pieces B7 and C2 were cut out in "B" and "C" directions respectively: also, test piece B1.S. was machined from the block removed from the other crank of the shaft. Results are set out in Table III, from which it will be seen that the material has been greatly improved as regards both ductility and yield ratio, the yield stress being now over 43,800 lbs. per sq. inch in every direction. In order to demonstrate clearly the effect of the oil quenching and tempering, the tensile tests before the heat treatment are collated in Table IV.

TABLE 3.

	Yield Stress. Lbs. per sq. in.	Max. Stress. Lbs. per sq. in.	Elongation %	Reduction of Area %.	Fracture.
Test Piece B7.	43810	74100	25.5	43.1	Fibrous
Do. C2. ...	45560	75000	20.0	31.0	Fibrous
Do. B1.S. ..	44170	79650	27.7	45.0	Fibrous

TABLE 4.

	Yield Stress. Lbs. per sq. in.	Max. Stress. Lbs. per sq. in.	Elongation %.	Reduction of Area %.	Fracture.
Direction "B."					
Before Heat Treatment:					
Test Piece B..	34180	70600	10.3	10.0	30% Woody
After Heat Treatment:					
Test Piece B7.	43810	74100	25.5	43.1	Fibrous 10% Crys'ne
Direction "C."					
Before Heat Treatment.					
Test Piece C.	29210	58780	14.0	17.8	Crystalline
After Heat Treatment:					
Test Piece C2.	45560	75000	20.0	31.0	Fibrous

All the tensile tests reported were made upon test pieces made to the standard size "D" of the (British) Engineering Standards Committee, which calls for a diameter of the finished test piece of .798 inch and a gauge length of 3 inches.

The material was subjected to examination under the microscope before and after heat treatment, so that the refinement of the coarse-grained structure of the original forging might be observed.

The forging machined quite satisfactorily in the slotter, planer and lathe, and it is hoped will soon be at work on its intended service.

THE DOMINION STEEL PRODUCTS COMPANY, LTD., BRANTFORD, ONT.

First Heat Poured in New Foundry

The recently completed large gray-iron and bronze foundry of the Dominion Steel Products Company at Brantford, Ont., witnessed the pouring of the first heat on June 15th.

The foundry equipment includes a 20-ton air furnace, a 72-inch cupola and a 44-inch cupola, giving an ample supply of hot metal for the pouring of a single casting up to the handling capacity of the foundry, which is thirty tons.

In addition to the gray-iron foundry, there is, on the mezzanine floor, a bronze and brass furnace of one thousand pounds capacity.

The Company has on its books a number of orders for castings varying in weight from 12 to 26 tons, together with orders for the numerous and different types of rolling mill, flour and rubber working rolls, heavy rolling mill equipment, rubber manufacturing machinery, and numerous smaller castings.

In order to keep its foundry supplied with patterns, the Company has decided to build a new brick and steel pattern shop 90 feet by 100 feet in dimension.

The foundry was originally built for the sole purpose of supplying castings for the Company's own machine shops but even at so early a date in its history, the advisability of doubling the floor space is being considered. Although organized only so recently as 1916, Dominion Steel Products has one of the most completely equipped machine shops in the Dominion, containing some of the heaviest and most modern equipment in Canada. The furnishing of a high grade of chilled-iron to the Canadian market is the Company's speciality.

Lansdowne Park, containing over fifty houses is a development of and is owned by this Company. In addition to the ground space occupied by its works, and Landsdowne Park, the Company owns an additional 26 acres, to be used for future development.

The Dominion Steel Products Company's operations are carefully described in an illustrated brochure just published, which among other things, shows interesting photographs of gun-mountings manufactured at Brantford for the United States Government during the war. Not only gun-mountings, but sights also were turned out by this Company, and these parts requiring great precision in finishing were satisfactorily produced. The Company has representatives in Australia, Brazil, Cuba, Central and South America and in South Africa.

SETTLEMENT OF MACHINISTS' STRIKE AT DOMINION STEEL PLANT

After a strike lasting for two months the machinists at the Sydney plant of the Dominion Iron and Steel Company returned to work on the terms offered by the Company, namely a wage increase of 11 per cent and a ten hour day, including double time for Sunday work and time and a half on Saturdays. The demands of the machinists were chiefly for a nine hour day. Under the new arrangement the maximum rate will be 68 cents per hour.

THE USE OF STEEL IN DWELLING HOUSE CONSTRUCTION

The increased cost of lumber in Canada, the realization of the enormous nature of the annual fire loss, and the growing tendency to use fireproof materials in building construction are notable at this time. A novel departure in dwelling-house construction in Britain is of interest to the steel industry as affording enlarged scope for steel products. The term "Steel-frame building" is generally associated with large structures such as hotels, public buildings and office blocks, but it was not to be expected to include small dwelling houses. According to the quarterly Journal of the Steel Structure Section of British Engineers' Association, a type of house has been evolved consisting mainly of a self-supporting steel frame covered with reinforced concrete, the nature of the covering being the same for walls, floors, roof, and if desired, bedroom ceilings also. This type of house is being erected by a large industrial concern in the north of England in connection with a garden city scheme now being carried out to provide housing for this company's workpeople.

The steel work necessary for a house consists of a series of tranverse frames set at regular intervals of about four feet, each frame consisting of two uprights one floor beam, and a light roof truss. This spacing of four feet was found to be the most economical, inasmuch as it gave suitable space for the size of cottage windows and doors, and also enabled the wall, floor and roof construction to be used to best advantage.

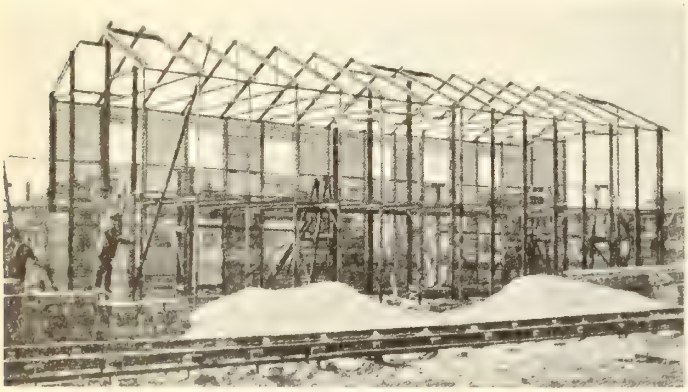


Fig. 1. Erecting Framework.

Fig. 2. Completed Dwelling.

Fig. 1 shows the steel framework for a pair of semi-detached cottages with parlor, with ribbing for retaining the concrete covering in process of being placed in position.

Fig. 2. Shows a completed house. Houses of this description can be built with or without cellars, and to suit Canadian conditions would have to be provided with concrete cellar walls, the use of bricks in what is intended to be a monolithic reinforced concrete structure not being admissable.

The design of the house was worked out by studying the house plan, the steel frame and the architectural requirements simultaneously, and such a procedure is quite essential for the successful application of steel framing to dwelling houses. The steel frame is much more than a system of supports for the other materials entering into the construction of a house. It is the basis of the whole design, and the treatment of room arrangement, window spacing and chimney brickwork must be subordinated to the standardized dimensions of the steel framing, and the ordinary conventions of construction of brick houses must be forgotten. Simplicity of design is an essential, and it is evident that houses of this novel type of construction will not lend themselves to such flexible and decorative treatment as brick or wooden dwellings.

In order to obtain simple and economical connections, rolled steel channels, angels and flats are principally used. All connections used on the site are bolts, and very little shop rivetting is necessary. The steel framing has been found in practice to be easily and speedily erected. Each piece is marked, and by followowing the key-plan no special plan is required in assembling the houses. The erection of the steel frame enables the roof to be completed at the outset of operations, so that much of the remaining work can be carried out under cover. In the locality where this class of houses has been erected the steel framework has been severely tested for rigidity at all stages of construction by a continuous series of heavy gales, and the finished houses are stated to be found dry and stable under the worst weather conditions. The British Ministry of Health has approved this type of house for adoption in housing schemes, and arrangements are being made for the fabrication of material for three standard types of houses, which agents of the manufacturers are undertaking to erect, in completed form, throughout Great Britain.

With some modifications that it should not be difficult to design houses of this type could be made that would suit the climatic conditions in Canada. The forgoing account is, however, more particularly given to our readers as suggesting that the use of steel in building construction may have a wider application than it has hitherto been conceived to have.

UNDERGROUND LOADING MACHINES TO BE MANUFACTURED AT PORT ARTHUR, ONT.

The Lake Superior Loader Company, Duluth, Minn., are having some "shuveloders" (underground loading machines) manufactured by the Port Arthur Shipbuilding Co. for sale in Canada. Later on they may organize a Canadian company and manufacture this product themselves, but of this there is no certainty at the present time.

W. H. McINTYRE APPOINTED GENERAL MANAGER OF OTTAWA CAR MANUFACTURING COMPANY, LIMITED

Mr. W. H. McIntyre, for 29 years connected with the Ottawa Electric Company and the Ottawa Gas Company has resigned the position of Assistant General Superintendent of these companies to become the General Manager of the Ottawa Car Manufacturing Company.

The Ottawa Car Company commenced as the W. W. Wylie Carriage Works which twenty-five years ago was incorporated as a joint stock company by by Thomas Ahearn and Warren Y. Soper and others connected with the street railway interests in Ottawa. The works of the Company now cover a large block enclosed by Albert, Slater, Lyon and Bay Streets, together with a large machine shop on the south side

MR. W. H. McINTYRE.

of Slater Street, where also a modern brass foundry and factory has just been completed.

In addition to the manufacture of cars, the Company during the war made a fine record in the making of gun carriages and limbers, and such military transport equipment as ambulances and general service wagons.

The new foundry is equipped to pour brass castings in brass and special mixtures, and a special feature of the company's business is the making of acid resisting parts for pulp and paper mills.

Another department of the Ottawa business is a motor-garage, equipped to accomodate 300 cars. Repair work is facilitated by the proximity of the Company's shops under one management, and this garage is an example of the important part now played in the metal-working trades in Canada by the automobile and motor-truck.

The New Foundry of the Ottawa Car Mfg. Co., Ltd.

CANADIAN INDUSTRIES EXHIBITION IN LONDON

Canadian Steel and Metal-Working Firms Display Products

In the absence of Sir George Perley, K.C.M.G., High Commissioner for Canada, the Canadian Indutries Exhibition was opened June 7th, at the Agricultural Hall, Islington, by Sir George McLean Brown, European manager of the Canadian Pacific Railway. The exhibition which is the first of its kind to be held in this country, is representative of Canadian industries. Amongst the exhibition of iron, steel, and engineering products are the following:—

Nova Scotia Steel & Coal Company Limited, New Glasgow N.S. This firm exhibits a large variety of steel products, including rails, angles, channels, and bars of various sizes..

The Dominion Iron and Steel Company, Limited, Sydney.—Various sizes of iron and steel sections, including rails, bars, angles, channels, and other shapes. Annealed and galvanized plain wires, wire rods, nails and staples, etc.

The Steel Company of Canada, Limited, Montreal. —Steel products of various sorts, including wire rods, bar iron and steel, wire, including galvanized wires; wire nails and screws, tubes, bolts and nuts, nails, etc.

The Dominion Steel Products Company, Limited, Brantford, Ont.—"Dominion" all-steel chucks, made of a special grade of crucible-steels casting, carefully annealed. The design of the "Dominion" chuck-body gives broad and deep T slots, which provide a thicker section between the face of the chucks and the bearing surface of the T. Other exhibits include cut gears, brass and bronze castings, etc.

Other exhibitors include the Dominion Machinery Company, Limited, Halifax, makers of wood working machinery; the Machine and Stamping Company, Toronto; Canadian Bronze Powder Works, Limited, Montreal, and Acadia Gas Engines, Limited, Bridgewater. The Sheet Metal Products Company of Canada, Limited, exhibit a variety of galvanised japanned, and stamped ware, while The Whitman & Barnes Manufacturing Company, St. Catherines, Ont., have a display of twist drills, reamers, wrenches, and other tools.

The Utilization of Titaniferous Iron Ore in New Zealand*

By J. A. HESKETT (New Plymouth, N.Z.)

New Zealand is wholly dependent on the outside world for all its iron, although it possesses at least two well-defined iron ore deposits.

At various times small companies have sought for short periods to develop these deposits, one at Para Para [a limonite ($3Fe_2O_3+2H_2O$), also found as lower hydrated oxides], and the Taranaki iron-sand, a combined magnetite and ilmenite ($2FeO + 2Fe_2O_3 + FeO + TiO_2$). The former is of massive variety, and the latter granular and mixed with various proportions of fine shell and siliceous sand well water-worn. This latter deposit forms the greater portion of the beach sands of the west coast of North Island. Its fineness can be gauged by the fact that a sample passed entirely through a sieve of 40 meshes to the inch.

The ilmenite cannot be detected by the microscope as it can in the titaniferous ores of the Adirondacks, nor can it be magnetically separated. To all appearances it is a definite double oxide of iron and titanium and not a mechanical mixture of the two, as in the Adirondack deposit and the titaniferous deposits of the Natashkwan Province of Quebec, where a very nearly complete separation can be made by magnetic separation.

Analyses of the two New Zealand ores are given, one from the published result of the Government Laboratory analysis of Para Para ore, and the latter the standard works analysis of the New Zealand Iron Ore Smelting and Manufacturing Co. at New Plymouth.

It may be advisable at this stage to advance a generally accepted theory as to the origin of the deposits on the coasts of New Zealand. They originated from one or more upheavals, at sea, of molten oxides which when in contact with the water immediately granulated. It is a known fact that it would require a high temperature and an abundant supply of water to give such fine granulation as is evidenced in this unique deposit. Both in this case would be forthcoming. The fact that throughout the soils of the interior a few grains can be collected, some far removed from the sea-front, can be explained by their having been windblown, like the shell-rock deposits which abound at various parts. This theory is in keeping with the author's investigations.

Analysis of Ore Deposits.

	Para Para Per Cent.	(Taranaki) Per Cent. Iron-Sand
Silica	9.56	2.20
Alumina	3.36	3.31
Ferric oxide	71.25	44.36
Ferrous oxide	1.94	33.91
Manganous oxide	0.65	0.64
Lime	0.51	2.16
Magnesia	0.10	2.83
Titanium dioxide	0.63	9.31
Phosphoric anhydride	0.35	0.59
Carbon dioxide	0.10	..
Alkalies	0.08	undetermined
Water and loss on ignition	11.84	..
Vanadic acid	..	0.28
Sulphuric anhydride	0.21	0.05
Iron	51.38	57.30
Phosphorus	0.15	0.25
Sulphur	0.08	0.02

The composition of the iron-sand will vary according to the locality, no two samples ever being identical, although at various points of the coast, where the concentrating action of the heavy sea has thrown up, and so concentrated, the blue-black oxide, the analysis is fairly constant. When, with calm seas, only the lighter siliceous material is washed up and the subsequent winds blow with force, the lighter and darker sands are soon mixed and so build the sand dunes which are very common on these foreshores, leaving the deposit very patchy. These dunes contain anything from 20 to 40 per cent of iron.

The deposits, although readily accessible at various points, are by no means inexhaustible in the European or American sense, although they would go far to supply the demands of New Zealand. There is no doubt that at certain points of the coast there are places where the concentration is everlastingly throwing up iron oxide. Whether it would form a sufficient source of supply is a debatable point.

The analysis of the iron-sand shows it to be very similar in composition to mill scale; practically all the gangue is free, excepting a little white silica, which can be detected under the microscope, attached to the blue-black oxide. This forms, however, only a small percentage of the gangue. The author has, with a hand-magnet, concentrated down to 98.6 per cent metallic oxides. It is suggested that it is the high ferrous oxide content of this ore that gives it its magnetic properties, and unless properly taken into account has the detrimental effect of retarding reduction in the blast-furnace, with the result that uncarburised metal reaches the hearth and so diffuses amongst the metal. This has been proved over and over again in all the attempts at smelting the iron-sands. It is often stated that the iron produced from iron-sand is sluggish and cannot be tapped from the furnace, or that only high carbon steel can be made from iron-sand, and that grey iron cannot be produced. These statements are based on experiments whereby only the same time for reduction of a soft haematite or limonite similar to Para Para was allowed for iron-sand. This has been the ruination of practically all attempts to utilise the iron-sands of New Zealand.

The author accepts the theory that, usually speaking, an iron ore low in ferrous oxide and high in ferric oxide is a more readily reducible ore than *vice versa*. Hence a premium is paid on these easily reducible ores. The iron-sand requires a greater percentage of direct reduction than is common on the easier reducing ores. The detrimental effect is shown by the following equations:

$Fe_2O_3+3CO=2Fe+3CO_2$. Thermal value $+426$ per pound of carbon.

The above is known as indirect reduction, or Grun-

---

* A paper presented at the Annual Meeting, May 1920 of the Iron & Steel Institute.

er's ideal in the working of the blast-furnace, where the CO does the greater portion of reduction.

It is natural to expect that an iron ore that will not yield up its oxygen to CO readily and depends on fixed carbon for reduction must give rise to a high $CO:CO_2$ ratio in the escaping gases and miss the more favourable circumstances for indirect reduction. Knowing the difficulty with which the iron-sand is reduced, and after giving due consideration to the circumstances, the author conceived the idea that if the reduction were made largely a direct one it would be more complete and the gases would be richer in CO, thus attaining the desired result.

With this in mind, a process of mixing coking coal and fine iron-sand in equal proportions and coking, was evolved. The resultant coke or ferro-coke contained 36 per cent metallic iron and 40 per cent carbon, and at the same time a greater portion of the oxide was reduced to a metallic state in the eight hours which elapsed in the coking process. This ferro-coke was charged along with the limestone into the experimental furnace (a furnace somewhat resembling a foundry cupola, 8 feet from charging door to tuyeres and 3 feet in diameter served with four tuyeres with a 6-ounce blast pressure, water-jacketed, and provided with water-cooled tuyeres).

As soon as the ferro-coke reached the tuyeres (which was about an hour after charging) the rise in temperature as between ordinary coke and ferro-coke was very pronounced, owing to a small proportion of the metallic iron in the ferro-coke oxidising and thus giving an exothermic reaction. This small amount of oxidised iron was deoxidised in the descent from tuyere to hearth.

At the tuyeres little globules of metal and slag could be seen sweating out of the ferro-coke compound and coalescing to form big beads of metal, and dropping to the bottom to collect, ready for tapping. This looked like an ideal process, giving a good iron under cold-blast practice, and producing 10 tons per day of very close-grained grey iron of the following composition:

	Per Cent.
Graphitic carbon	2.82
Combined carbon	0.75
Silicon	0.91
Manganese	0.42
Phosphorus	0.56
Sulphur	0.04
Titanium	0.28

After repeated experiments this process was, however, abandoned, the unexpected trouble being due to the friable nature of the ferro-coke at incandescent temperature, causing a mass of finely-divided coke to become entrapped in slag and gradually settle in and contract the working area of the hearth.

The technical explanation of the cause of the disintegration at high temperature was the formation of amorphous carbon (plainly visible if a piece of ferro-coke were withdrawn by tongs from the furnace through the tuyeres, allowed to cool and broken), similar to lamp-black, and to the carbon deposition in an iron ore in the tops or any ordinary blast furnace under certain conditions.

What the result of hot-blast instead of cold-blast on the "fines" from the ferro-coke would have been is a matter of conjecture only. The method of reduction (a direct one evolved in the coking process) was highly satisfactory. The idea of keeping as close to the above principle of reduction as possible, yet modifying it to obviate the disintegration troubles, led to a process of mixing one part of coal with three parts of sand, and as this mixture was a little short of binding properties, and also as plant to grind the two materials finer was not available, resource was had to a very weak solution of sodium silicate to assist bondage, briquetting and coking. The briquettes were charged in the experimental furnace of cupola design, as described, along with coke and limestone, and smelted. The result was the absence of any "fines" whatsoever and free running slags; but the iron was white, mottled, and low in silicon, namely, 0.4 per cent, also more carbon was used per ton of iron produced than in the previous process, and the daily production was a little less.

Any difference in the quality and quantity of iron produced from the combinations of these different processes in the same furnace and under the same condition was due to the preparatory treatment the compounds received. No. 1 compound (one of coal to one of sand mixture) was coked in a retort, and the time taken was eight hours, which was sufficient to reduce the bulk of the iron oxides to a metallic state, and, in a greater measure, the material nearer to the edges of the retort than that at the middle of the charged retort. The resulting compound is simply finely divided, deoxidised, semi-carburised iron mixed with coke; and in smelting this small portion of iron content it decarburises and oxdises at the tuyeres, giving a higher temperature in the hearth, akin to hot-blast, and yielding higher silicon iron, which accounts for the grey fracture. The No. 2 compound (three of sand to one of coal) had no doubt sufficient carbon to deoxidise the ore, but the short space of time in carburising this compound, namely, thirty minutes, was not sufficient time to deoxidise the ore—in fact, this was to be avoided, as the compound would disintegrate unless cintering were resorted to. Hence this compound was charged into the short furnace, and such reduction as took place was direct, a few feet above the tuyeres, with a lower yield of iron of low silicon content and a somewhat higher coke consumption (approximately 27 cwt. to the ton of iron). The better process commercially was that with No. 1 compound if disintegration could have been avoided.

The results of compounding with sand and coal gave an impetus to the idea of cintering the iron-sand, and as the reduction in smelting would be indirect the furnace height was raised to 51 feet and charging effected by an inclined skip-away. The cinter was broken down to 1-inch mesh and charged as usual with ore and coke practice. The iron produced was steely uncarburised iron with a scouring slag, clearly proving the results of the two previous methods to be consistent. The idea of cintering this refractory magnetite and ilmenite was thereupon abandoned.

A stage had been reached where the indifferent quality of iron produced by cold-blast practice on the compounds, as described, necessitated expert advice to warrant the expenditure which was anticipated as required to bring the process to perfection. Mr. Aubel, a metallurgical engineer, then engaged in Australia, was invited to visit, report, and advise, and on his recommendation a hot stove was installed and the height of the existing furnace increased.

Eventually the U-pipe hot-blast was installed, and the process was brought more in keeping with ore re-

duction in modern practice, relying upon a greater percentage of indirect reduction yet involving a direct one if required, when a mixture of eight parts of sand to one part of coal was used.

The furnace used was 45 feet high, with a vertical height of 8-feet bosh; a 4-foot diameter hearth; bosh angle 70 deg., and a bell and hopper, hand operated. The blast (with a pressure of 20 ounces) was raised to 1000 deg. F., and the bosh was water-spray cooled, and both tuyeres and coolers were water-cooled.

The binding power of the coal in an eight of sand to one of coal mixture was raised by fine grinding the sand and coal together to an impalpable powder in a Fuller-Lehigh mill. It was then briquetted in an ovoid briquette machine and carbonised. The resultant briquette contained 50 per cent of iron.

The furnace was blown in on this trial, and the first tap (about 1 ton) was an 8 per cent silicon iron (ferro-silicon). As this burden was only 15 feet above the tuyeres it showed that the direct portion of reduction was satisfactorily doing its work. The second tap (3 tons) was 2.5 per cent silicon, and it subsequently averaged 1.6 per cent silicon until the blow out. The coke consumption was very high, averaging 35 cwt. per ton of pig produced in the early stages, which later increased to excessive amounts in the form of blank charges to surmount obstructions in the hearth just below tuyeres. These obstructions eventually proved to be titaniferous accretions which were accumulating and gradually raising the bottom until it reached high enough to prevent tapping. Instead of mitigating the titanium deposits, forcing the heat had the contrary effect, and contributed in no small measure to the closure to this trial much earlier than it would otherwise have been.

The amount of pig iron produced was 50 tons (averaging 5 tons per day). The following is an average analysis of the iron produced:

	Analysis of Iron Per Cent.
Graphitic carbon	2.89
Combined carbon	0.70
Silicon	1.60
Manganese	0.45
Sulphur	0.06
Phosphorus	0.51
Titanium	0.63

	Av'ge Slag Analysis. Per Cent.
SiO_2	30.7
Al_2O_3	17.6
MnO	0.5
FeO	1.0
CaO	31.2
MgO	4.1
K_2O | Na_2O	2.6
TiO_2	10.2
S	1.2
V	undetermined

The slags were very fluid, and no trouble was experienced in handling them. The titanic acid content would lead one to believe that it had lowered the fusion point as well as the viscosity of the slag. At times the titanic acid content was brought up to 20 per cent in an experiment on subsequent trials, and the fluidity was in no way impaired, so the theory of viscid slags due to abnormally high titanic acid content might very easily be disproved.

The accretion which built up in the hearth was of a greyish colour and filled the spaces between the coke in the hearth, leaving a solid mixture of coke and ferro-titanium with cinder entrapped. The ferro-titanium was magnetic, and when struck with a hammer showed the well-defined metallic appearance. The stony fracture was caused by the non-metallic cinder being incorporated in and around the metallic portion.

The analysis of the combined cinder and metallic ferro-titanium was as follows:

	Per Cent.
Fe	46.5
Ti	16.5
FeO	0.4
MnO	0.2
SiO_2	11.6
Al_2O_3	6.1
CaO	11.1
NgO	1.6
TiO_2	3.8
S	undetermined
P	undetermined
V	undetermined
Alkalies	undetermined
	97.8

Another sample was crushed very fine (as fine as the metallic portion would allow), and separated over and over again by a hand-magnet under water into metallic and non-metallic particles with the following results:

	Magnetic Per Cent.
Fe	66.5
Ti	26.1
Si	3.7
S.	0.1
P	0.4
Mn	0.5
C.	2.1
V.	0.5

	Non-Magnetic. Per Cent.
SiO_2	17.9
Al_2O_3	20.1
TiO_2	39.3
CaO	12.5
MgO	6.1
S	0.8
Alkalies	undetermined
V.	"
MnO.	"
FeO	"

An interesting sidelight on this titaniferous deposition was thrown on examining a sample of the slag which flowed through the tap-hole after casting iron. This slag, which was allowed to settle in a sand-well arranged for it, showed when cooled a clear line of demarcation between a top and bottom layer of different coloured slags, and on examination showed metallic material settled at the bottom and intimately mixed with cinder.

The analysis of the top and bottom layers were as follows:

	Top. Per Cent.
SiO_2	33.3
Al_2O_3	15.6
MnO	0.5
TiO_2	9.9
CaO	34.6
MgO	2.1
FeO	0.2
S	1.4
Alkalies	2.1
V	undetermined
	99.7

	Bottom. Per Cent.
SiO_2	26.1
Al_2O_3	21.4
MnO	undetermined
TiO	13.7
CaO	23.5
MgO	0.9
FeO	0.2
S	1.3
Alkalies	undetermined
V	"
Fe	11.3
	98.9

The top layer was of a sky-bluish tint, with a stony fracture, crystalline at the heart, and with a somewhat vitreous appearance at the edge. After weathering it showed no sign of rust.

Under the microscope the same portion showed a massive formation with here and there a few crystalline formations, but no sign of metallic particles.

The bottom layer had a dark bluish tint, with a metallic material spangled throughout. It was dense on the bottom of layer, but less so as a line of demarcation was reached. Here and there in this metallic portion a coppery-coloured deposit was perceptible. The bottom layer had a higher specific gravity than the top layer, viz. 3.8 to 3.2, and this sample if allowed to weather showed a rust formation on the bottom layer, the top remaining unaltered.

Under the microscope this bottom layer showed a matted mixture of metallic material and crystalline slag of quartz-like appearance with a violet tint. The metallic portion was partially globular and of graphitic appearance, interwoven with slag.

The iron thus entrapped in this slag was a direct loss, and to see whether it was at all fusible the top and bottom layers were melted in a small clay assay crucible (about 2 inches diameter). The top layer melted rapidly and was fluid at approximately 2600 deg., but the bottom layer became pasty only at 3000 deg. F., never flowed at all, and came out of the crucible like a ball of dough. This ball was hammered with a wooden mallet, and flatened out like a piece of iron to about ¼ inch thick and 6 inches in diameter. It required a sharp blow to break it.

On another occasion a tap of slag was allowed to settle in the slag ladle, and as a little iron had come over (about 50 lb.), this showed a conical-shaped button of iron and then a layer of ferro-titanium in a matrix of slag. This material when tested withstood fusion at 3000 deg. F.

From the foregoing results the idea was conceived that it would be possible, by tapping at short intervals, to tap both slag and iron through the tap-hole, the assumption being that the material in the hearth, just on tapping time, was as shown in Fig. 1.

The iron in the hearth was assumed to be about a 12-inch layer, titaniferous material 2 inches and slag 2 feet. Naturally as the iron flowed out of the tap-hole the titaniferous material would follow and be flushed with the slag following as long as there was plenty of such slag.

The above diagram shows a sandwiched material of pasty character, which will not flow from the furnace unless it is flushed as an inert material in a fluid slag.

This method of flushing was adopted at a later trial after the hearth had built up 2 feet above the original tap-hole, and the furnace was tapped regularly every two hours and finally the hearth was reduced at tap-hole side to the original tap-hole, but the back side of the hearth was built up as shown in Fig. 2.

It might be imagined possible to tap on either side of furnace alternately and thus keep both sides clear, but this was never tried.

From the above experience the author estimated that approximately 85 per cent of the TiO_2 content of the iron ore was accounted for as a constituent in solu-

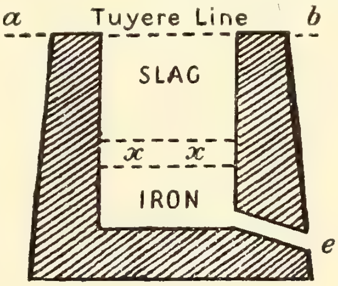


Fig. 1.

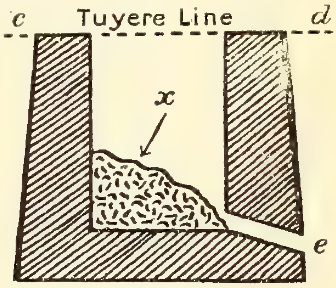


Fig. 2.

tion in the slag. The balance, viz. 15 per cent., was made up of approximately 5 per cent of a high TiO_2 cinder and 10 per cent of ferro-titanium.

The explanation of the above figures is that the TiO_2 content of the ore is approximately 10 per cent, and the balance of the gangue will total approximately 10 per cent. If no other slag-making material were added to furnace burden and the ash of coke be assumed to be nil, a very refractory slag would result almost infusible and containing approximately 50 per cent TiO_2. The author's contention is that the gangue in the ore on the iron being liberated in the bosh of the furnace is composed of approximately 50 per cent TiO_2, 11 per cent SiO_2, 16 per cent Al_2O_3, 10 per cent CaO, and 13 per cent MgO. This would form an infusible slag in blast-furnace practice, and this refractory cinder, unless it coalesced with the CaO from the limestone of the burden during descent to hearth, will reach the hearth, where it is doubtful whether the bath of slag will absorb it totally, as being of higher specific gravity it will sink to iron level of the molten material in the hearth. The amount that will come to the hearth uncombined with CaO during descent is problematical.

Again, if it came unmixed with lime in proper proportions, how much of the high TiO_2 cinder would combine with the molten bath of slag in the hearth in passing from the top of the bath to the bottom is conjectural; but there is one point certain, and that is, that when the iron and slag are tapped and the fur-

nace hearth is "dry," the chances of the high TiO_2 cinder reaching the hearth are great, and although the amount may be small, say 0.1 per cent, this amount will only require time before it produces a crisis.

The following analysis of a sample of cinder from the hearth corroborates the foregoing:

	Per Cent.
TiO_2	52.1
SiO_2	9.5
Al_2O_3	15.6
CaO	13.3
MgO	7.3
S	1.1

This sample when heated in a clay crucible to 3000 deg. F. was mushy, but when ground and intimately mixed with limestone in proper proportions and heated to the same temperature was very fluid.

This sample was almost free of metallic material and was hard and brittle, with a dark grey stony fracture, and was taken from between two pieces of coke which had become entrapped. It is worthy of note that although the accretions are high in TiO_2, no two samples would give identical chemical results and would vary from between 40 and 50 per cent., due no doubt to the amount of slag the high TiO_2 cinder generally takes up in transit to hearth from the ash of the coke. This, by the way, was very low, approximately 1 per cent. The mushy TiO_2 cinder generally had entrapped metallic titaniferous material and at times graphitic iron almost free from titanium, although this varied considerably.

The author now assumes that if the high titaniferous ore were composed of sufficient gangue to make a self-fluxing burden the hearth troubles would be at an end. In the case of iron-sand the lime could be intimately mixed and either cintered or briquetted to give a self-fluxing ore. Under these conditions the gangue, once free from the iron, could journey to the hearth as a very fluid slag, with no chance of depositing TiO_2, as the TiO_2 in solution will not precipitate out. This process is the subject of patent, and it will be interesting to watch the result of a trial which is about to be undertaken.

Any metallic material, such as ferro-titanium compounds, would no doubt result from what took place before the tuyeres, where the high temperature is sufficient to reduce by direct reduction a portion of the TiO_2 and to alloy with iron and carbon. This alloy will no doubt be absorbed in the bath of iron up to saturation point, and any excess, if not flushed away in slag, might be readily absorbed by iron intermittently charged from a burden of non-titaniferous ore.

The author is convinced that TiO_2 will form up to 20 per cent of a slag, as proved in practice, and that this slag is as fusible as any blast-furnace slag.

He has watched the slag flow from the cinder notch and observed scintillations of what he imagined was iron, oxidising. On investigating he found practically no FeO in the slags, or not enough to lead to the large amount of scintillation which takes place, hence he believes it to be due to metallic titanium in suspension in slag, and oxidising.

There is no doubt that the flushing of both slag and iron through the tap-hole at short intervals will overcome the titaniferous accretions, but this method is uneconomical on the score of the loss of iron involved. It is quite possible that the alloy (ferro-titanium, which is very easily reclaimed, especially where granulation is resorted to) could be used in steel manufacture as additions, when required, and if the carbon content be not too high. This would make this method a commercial as well as scientific success. Even where granulation was not resorted to, the flushed slag could be crushed and the magnetic portion recovered by passing the crushed material over a magnetic separator. Under the circumstances a very satisfactory method would be to mix an ore of non-titaniferous content in proportions best adapted to absorb the precipitated titanium-bearing alloy. The amount of absorption would vary according to the hearth temperature. Practice seems to give 0.6 per cent of Ti as an average point at which absorption ceases.

If his contention as to the amount of TiO_2 in solution in slag as against the metallic Ti produced be correct, 50 per cent of a non-titaniferous ore and 50 per cent of titaniferous ore of approximately 10 per cent TiO_2 content, mixed, will make a good and successful mixture to handle the accompanying titanium.

This theory has verified itself in practice at Port Henry, U.S.A., where Mr. Bachman reports satisfactory results from mixing non-titaniferous and titaniferous ores.

Whether the practice of mixing the two ores is a benefit to foundry practice or not remains to be seen. The author's experience is that the pig iron produced from titaniferous ore will not grain out like other iron of similar analysis. It has a ready tendency to chill even in ordinary sand casting, with silicon 2.5 per cent and sulphur 0.04 per cent. This chill is only to a depth of 1-32nd of an inch on the above analysis. The iron is exceptionally strong and tough, easily standing 25 per cent greater breaking strain and deflection, as shown on a standard testing machine. Castings made from this iron have a wonderful finish, surpassed by no other iron used in the author's foundry experience. Where extreme softness is required in thin castings there are founders who object to this iron. Personally, he believes it to be more adapted to steel production than everyday foundry work. For steel it is eminently suitable, and steel which has been produced from this iron has exceptional strength, ductility, and malleability.

FIRE DAMAGES MARITIME BRIDGE COMPANY'S PLANT AT NEW GLASGOW.

A fire on July 7th gutted the main workshop of the Maritime Bridge Company at New Glasgow, but the powerhouse, offices and companies' shop were saved. About two hundred men will be temporarily thrown out of work, although the plant has recently been unable to work at full capacity owing to inability to obtain deliveries of steel. Maritime Bridge Co. is a subsidiary of the Dominion Bridge Company, and the fire occurred the day previous to the annual directors' meeting. Maritime Bridge has always been able to obtain a comfortable supply of local orders, New Glasgaw being the most important centre of steel construction work in Nova Scotia, and it is to be expected that plans for re-building will be shortly announced. Mr. R. B. Stewart is the Resident Manager.

SCOTIA STEEL WORKERS OBTAIN TEN PER CENT WAGE INCREASE

Pursuant to the recommendation of a Conciliation Board the steelworkers at the Sydney Mines Plant have received a ten per cent increase in wages.

The Iron Ore Occurrences in Alberta

(From the First Annual Report of the Mines Branch on the Mineral resources of Alberta.)

(By PROF. JOHN A. ALLAN)

The object of this report was to determine the possible occurrences of iron ore in Alberta which might be mined economically and manufactured within the province where there is an ample supply of coal and natural gas for fuel. Another object was to investigate various newspaper and individual reports regarding the occurrences of extensive deposits of iron ore which were awaiting development in this province

In making this investigation all obtainable information was procured from publications issued by the Geological Survey, the Mines Branch and the British Columbia Bureau of Mines; geologists and mining engineers who were acquainted with specific regions were consulted in person or by correspondence; the more accessible localities were visited, the geological structures examined and average samples taken for analysis.

All available information from other sources was carefully considered, such as from interested individuals, newspaper items, and reports written for companies or interested parties.

Iron occurs in Alberta in several forms, and at many localities, but up to the present time, no deposits have been found of such size and quality as to warrant development. There are, however, very large unprospected areas north of Alberta and Saskatchewan in which iron ores of commercial value may yet be discovered. Since Alberta has an unlimited supply of coal, the presence of iron ore of even moderate grade, if in sufficient quantity to be mined economically, would prove to be an important asset with the growth and development of the industrial market in the western prairie provinces. Even if commercial deposits of iron ore were found in eastern British Columbia these would prove valuable to this province.

Types of Occurrences.

1. Ironstone nodules in bands or as scattered nodules.
2. Ferruginous shales.
3. "Iron formation" (hematite) in pre-Cambrian areas north of Lake Athabaska.
4. Limonite and bog iron spring deposits of local distribution.
5. Magnetite shales.
6. Sheep River deposits.
7. Hematite deposits in eastern British Columbia.

Ironstone Nodules.

Ironstone and clay nodules saturated with iron are are widely distributed, and are abundant in the fresh-water and brackish-water sandstones of upper Cretaceous age throughout the province. These formations are exposed along the Red Deer, Battle, South Saskatchewan, Belly and Bow Rivers. At many points, especially along the Red Deer River, an accumulation of the ironstone nodules has resulted from the disintegration and weathering of the soft Edmonton and Belly River sandstones. In the vicinity of Drumheller and also in the vicinity of Sand Creek north of Brooks such accumulations can be seen. In no locality are these deposits of economic importance.

Specimens of these ironstone nodules can be obtained which are high in metallic iron, but the quantity of such material is decidedly limited. The following analysis of clay ironstone from the river, 20 miles north of Brooks was made by F. G. Wait of the Mines Branch,* "A light, clove brown, compact, massive ironstone." It yielded on analysis:

Metallic iron	57.22
Insoluble mineral matter	7.36
Titanic dioxide	None

Another sample of clay ironstone was analysised by F. G. Wait "from a short distance east of Bellevue, on the line of the Crows Nest Pass railway."

"A brownish-grey, reddish-brown weathering, compact, massive ironstone, with which is associated a small quantiy of limonite."

"It was found to contain:

Metallic iron	36.16
Insoluble mineral matter	12.20
Titanium dioxide	None."

A more representative sample is referred to by J. B. Tyrell in his description of the ironstone on the Red Deer.** "In some places along the outcrop of the beds of the Edmonton series, and notably on Red Deer River west of the Hand Hills, a large quantity of clay ironstone is scattered over the face of the clay and sandstone banks, and over the surface of the aluvial flats, which stretch between them and the river. Samples of ironstone similar to that which is here seen, have been analyzed by Mr. Hoffmann, and found to contain from 22 to 34.90 per cent. of metallic iron. It occurs, however, in the rocks in very irregular lenticular bands and nodules, so that after what is lying on the surface had been collected, the work of digging it from the banks would give irregular uncertain results."

Clay ironstone nodules also occur along the Peace River in corresponding formations and the occurrence is described by R. G. McConnell.*** Clay ironstone in nodules and thin beds, is of universal occurence in the Cretaceous shades of the region, but is especially abundant in some of the outcrops of the Fort St. John shales on Peace River, between Battle River and the mouth of Smoky River. The ironstone here, owing to the rapid erosion of the soft shales has been silted out, and in many places forms thick acumulations at the foot of the cliffs, lining the valley, some of which which may prove to be of economic value. The Pelican sandstone on the Athabaska is usually capped with a bed of hematiferous sandstone varying in thickness from a few inches to four or five feet. A specimen of this rock was examined in the laboratory of the Geological Survey, and found to contain 12.4 per cent. of metallic iron."

Along the Athabaska valley below Fort McMurray, Ells note the occurrence of iron ore float, but this de-

---

*Wait, F. G., Mines Branch, Can., No. 59, 1909, p. 69

**Tyrell, J. B., Geol. Surv., Can., Ann. Rept.., 1886 p. 150, E.

***McConnell, R. G., Geol. Surv., Can., Ann. **Rpt.** 1890-91, Vol. V., p. 63 D.

posit had no commercial value.* "During the course of the season's work, fragments of iron ore float—up to 15 pounds in weight—were found at a number of points to Steepbank and Moose Rivers. At a point on Steepbank River 4.9 miles from the mouth, two small excavations, 40 feet apart, were made in the northeast bank. In each instance a thin capping of bituminous sand overlies a compact bed, one to two feet in thickness, and made up of fragments of siderite up to 20 pounds in weight. These fragments are not waterworn nor pitted as would be the case with float that had been carried any distance. A bed of clay, one to four feet in thickness, underlies the iron ore, and itself rests upon well bedded Devonian limestones."

"A representative sample of the iron ore analysed by Mr. H. A. Leverin gave: Iron, 35 per cent; insoluble, 18 per cent."

Ferruginous Shales

Another occurrence of iron is found in a certain brown shale formation which outcrops along the inner foothills, and within the front ranges of the Rocky Mountains. This ferruginous formation has been traced from the International boundary northward beyond the Athabaska River, but at no place has the quantity or the quality been found to be of economic importance. D.B. Dowling describes the character of these beds where they outcrop along the Athabaska River in Jasper Park.** "Some of the shale bands which separate the heavy bedded limestone formation contain a certain amount of iron oxide. In some cases these beds have a distinctly brownish color, and samples, showing enrichment of the lower beds by infiltration from higher levels, are found, which could be called ores. These, if found in sufficiently large bodies may be mined, but exploitation sufficient to establish their prescence in such quantity has not been undertaken. Claims for iron have been staked on the face of Fiddle mountain (between Fiddle and Drystone creeks) on a band of iron-bearing black shale which lies between the heavy limestone formations. The greatest impregnation of iron oxide is to be found in a series of silicious shales between the limestone and the coal-bearing rocks above. As red bands, these rocks have been traced northwards from the Kananaskis River, and their greater thickness, compared with the lower shales, should increase the possibility of finding in them mineable portions, though, as a rule, they would be of low grade. The smelting of these ores might be made possible by the reduction of the siliceous material by concentration.

Iron Formation

On the north shore of Lake Athabaska near Black Bay, there occurs a series of rocks which Camsell has called the Tazin series. The upper member of this series has been called the iron formation by Alcock, who described it as follows:*** "The upper member of the group consists of an iron-bearing series, made up of white quartzite, banded, cherty, ferruginous quartzite and cherty quartzite, interbanded with hard blue hematite. The quartzite is dense and hard and has been much fractured; concentration of the iron has been limited to small, local, well-leached patches."

"At several places the Tazin series contains considerable quantities of hematite and a number of claims have been staked on these deposits. Two types are represented: (1) shear-zones in hematite-bearing quartzite; (2) concentrations by the leaching of silica from the iron formation.

"An example of the former type is found northeast of Black bay. In a highly sheared zone the regional quartzite has gone over into a sericite schist. The zone contains considerable quantities of red hematite but the concentration has been insufficient to produce any valuable ore and the deposit itself is very limited.

"The second type of deposit is seen in the Beaverlodge syncline. The upper portion of the series, as already described, consists of interbedded hematite and quartzite. The structure consists of a syncline with dips on the limbs up to 70 degrees, and pitching to the southwest of an angle of 30 degrees, disappearing under the lake. The total area of the iron- bearing portion exposed covers only 250 acres. The hematite varies from a hard blue variety and is highly siliceous, except in well-leached patches. Evidence of the leaching of silica is seen in the transition of the quartzite into hematite with porous rock adjacent to the latter and in the fact that the hematite is found in cavities and along facture planes where circulation would favor leaching. The high grade variety is in too small quantities to be economic importance in that region. An analysis of a specimen of hematite from this locality gave the following percentages: Iron, 66.70; silicon, 2.12; phosphorus, 0.014; sulphur, 0.013."

At Tsu Lake Camsell found the same formation in the Tazin series.* "The Tsu Lake area is situated northeast of Lake Athabaska. The rocks have been grouped into the Tazin series which is pre-Cambrian in age and is the oldest known series in the region. They are intruded by granites and gneisses.

"This series contains lenses of iron formation. These lenses of iron ore are unimportant, but their presence affects the compass appreciably, so that the magnetic declination varies several degrees in different parts of the lake.

"The district is worthy of further investigation by the careful prospector, as larger bodies of iron ore might be found in the iron formation in the Tazin series of rocks."

Limonite, Etc.

Small deposits of limonite, bog iron, and yellow ochre are common, but no deposit has yet been described as workable in size and quality.

There are numerous iron springs along the sides of valleys and also on the plains, which have deposited yellow ochre, and in some the vegetation has been replaced by limonite, but those deposits on record are relatively small and of no important value. Oxide of manganese (wad) is also associated with many of the spring deposits.

Samples of ochre have been sent in to the department, having fair qualities, from the vicinity of Athabaska landing, from the foothills region and from

---

*Ells, S. C., Mines Branch, Dept. of Mines, Can., Sum. Rept., 1914, p. 63.

**Dowling, D. B., Geol. Surv., Can., Sum. Rept., 1910, p. 158.

***Alcock, F. J., Geol. Sur., Can., Sum. Rpt., 1916, p. 154 and 155.

*Camsell, Charles, Geol. Sur., Can., 1916, Memoir No. 84.

various points in the valleys of the North Saskatchewan, Red Deer and Battle River.

A sample of limonite from Red Deer River, east of Knee Hill, was analysed by F. G. Wait of the Mines Branch and found to contain:*

Metallic iron	49.45
Insoluble mineral matter	7,20
Titanium dioxide	None.

There is a reposit of limonite known to occur on the north side of the North Saskatchewan River under the muskeg at the head of Redclay Creek, about 15 miles northeast of Pakan. Samples which I have examined are of the loose earthy bog iron type and of good quality. This deposit is reported to be extensive, but no detailed examination has yet been made, and the depth of the deposit is not known.

Within the Rocky Mountains small deposits of limoneit have been reported from several localities. I have examined ochre deposits on the slopes of the Bow Valley, south of Castle station, between Storm mountain and Copper mountain, and deposits of ochre from Chalybeate Springs on the Vermilion River in British Columbia west of the pass by the same name; but these occurences are small and are not valuable.

Magnetite Shales

In the vicinity of Burmis station in Crows Nest Pass, 9 miles east of Blairmore, Alberta, iron bearing beds occur interbanded with a series of soft, coarse sandstones. These beds have been traced over 8 miles to the northwest. There are at least three iron bearing beds made up of hardened, black, magnetic sands. Considerable development work has been done on the deposits principally on the Gardiner Group of claims. The thickness bed is shown to be 10½ feet and another band has a thickness of 8½ feet. The southern end of this deposit lies about one mile north of Burmis station. This is the only portion of the deposit that I was able to visit this season. In the small, open cuts two beds of iron ore are exposed. The larger bed is about five feet in width and the smaller one somewhat thinner. On the surface there appears to be a considerable thickness of ore because the beds are dipping at approximately the same angle as the slope of the hill so that the outcrop of the ore is very much wider than the natural width of the iron bearing bed.

The ore is magnetite, but all the analysis made from samples collected from various portions of the deposit show that there is a very high percentage of titanium in the ore. An analysis of an average sample gave about 40 per cent of metallic iron and 5.5 per cent. of titanic acid, so that this ore is not suitable in its natural condition. The presence of titanium in the ore raises the fusion point of the charge in the furnace so that it has the efect of freezing the charge. It is possible that the titanium shown in the analysis may be due, at least in part, to the presence of rutile or sphene or some other titanium mineral; if this is the case, a product might be obtained by some method of magnetic concentration, sufficiently free from titanium to be of commercial value. On the other hand, if the titanium is present as an impurity in the magnetite, no metallurgical process has yet been found which would concentrate the ore from such impurity.

A number of samples of this ore were collected and detailed examination will made on them in order to ascertain the nature of the titaniferous material in the ore, and the possibility of concentrating this ore so that it can be smelted.

The following analysis were made from representative samples of iron ore from this deposit. No 1 was made from samples from which I collected from the southern end of the deposit one mile north of Burmis. This analysis was made by J. A. Kelso in the industrial laboratory in the University of Alberta. No. 2 is a sample taken from the richest looking material in the same locality as No. 1. No. 3 was made from a sample taken across the ten and a half foot bed towards the north end of the deposit. The samples Nos. 2 and 3 were collected by W. W. Leach of the Geological Survey and the analysis was made by the Mines Branch, Ottawa, in 1911.

	I.	II	III
	p.c.	p.c.	p.c.
Metallic Iron	59.08	55.50	39.80
Silica	4.03	12.53	18.33
Alumina	2.30	....	....
Ferric Oxide	84.40	....	....
Lime	0.09	2.78	2.21
Magnesia	....	0.52	2.25
Titanium Dioxide	3.42	5.74	5.56
Phosphorus	none	0.10	0.073
Sulphur	.09	trace	trace

This deposit seems to have considerable extent, and, if the percentage of titanium in the ore can be reduced by concentration, the ore might become commercially valuable. In the present state of the ore it is of little value and yet this is one of the most important deposits known at the present time in Alberta.

W. W. Leach of the Geological Survey, examined this deposit in 1911 and reports as follows:* "At the end of the season a hurried visit was made to a number of iron claims in the vicinity of Burmis station, about 9 miles east of Blairmore These claims have been prospected by means of open-cuts and a short tunnel along a line extending for about 8 miles northwards from a point near Burmis station; most of the prospecting, however, having been done near the northern extremity of this line on the headwaters of Cow Creek.

"The iron-bearing beds occur interbedded with a series of soft rather coarse, light-colored sandstones which outcrop along the foothills two or three miles east of the Livingstone range. This range is composed of Paleozoic limestones with a narrow belt of the coal bearing Kootenay formation, evidently with a faulted contact, lying along its eastern flanks. The sandstones series containing the iron-bearing beds apparently forms part of the upper Cretaceous group which extends eastward towards the prairie, but as no fossils were found and its stratigraphical relations not seen, its proper horizon is not known. It is evident. that the great fault noticed in the Crows Nest valley near Burmis must extend northward, a short distance east of the Livingston range, and with its eastern downthrow brings together the Kootenay rocks and the upper Cretaceous.

"On the most northerly claims, where most work has been done there are at least three iron-bearing beds contained in a thickness of not more than 250

*Mines Branch, Dept. of Mines, Can., 59, 1909, p. 69.

*Leach, W. W., Geol. Surv., Can., Sum. Rept., 1911, p. 199.

feet of strata; the rocks here, however, are rather severely folded, causing difficulty in identifying the beds on which the various openings have been made.

"In the valley of a small creek, rising in the Livingstone range, three distinct beds were seen, on the middle one of which a tunnel about 100 feet in length has been driven with a cross-cut 34 feet long, driven to the west, at the end. The tunnel and thefirst 20 feet of the cross-cut are in ore, but unfortunately this work was done on the axis of a synclinal fold with gentle dip on its easterly limb and slightly overturned to the west, the result being that at the tunnel entrance the ore is lying almost flat while at the end of the cross-cut it is standing vertical. The ore is somewhat fractured, is much slickensided, and shows considerable calcite developed along fracture planes. It is impossible at this point to gain a fair idea of the size or quality of the deposit. About two hundred yards to the south of the tunnel an open-cut on the same bed also near the axis of the syncline shows it to be 8½ feet thick and fairly uniform in character.

"Another open-cut about one-half mile south of the tunnel exposes a second bed which is probably below the first and is here 10½ feet thick. The strata at this point are nearly horizontal, dipping from 5 to 8 degrees to the west, and the ore appears to be of a very uniform nature. A sample taken across the bed in this cut was analyzed by the Mines Branch with the following results:

Fe (metallic)	39.80 per cent.
S_1O_2	18.33 per cent.
CaO	2.21 per cent.
MgO	2.25 per cent.
TiO_2	5.56 per cent.
P	0.073 per cent.
S	trace

"The writer was informed that there are a number of other openings both to the north and south of this point, but none of these were examined with the exception of a couple of small cuts, about one mile north of Burmis, where two beds of iron ore were seen. The ore, where stripped, was found to be dipping with prac- the same angle as the slope of the hill so that it was difficult to measure the thickness of the beds, the larger bed showing about five feet and the smaller three feet of ore with the top in neither case clearly defined.

"A sample of the smaller and richer-looking bed was taken and analysed by the Mines Branch, the results being as follows:

Fe (metallic(	55.50 per cent.
SiO_2	12.53 per cent.
CaO	2.78 per cent.
MgO	0.52 per cent.
TiO_2	5.74 per cent.
P	0.10 per cent.
S	trace

"It would appear that this deposit consists of a number of beds of indurated black magnetic sand, probably in the form of an ancient shore concentration. Under the microscope the ore was seen to be composed of more or less rounded particles of magnetite, quartz, and augite with a little secondary calcite, apparently derived from plagioclase, the whole being cemented with iron oxide. It is possible that the titanium dioxide shown in the above analysis may be due, at least in part, to the presence of sphene or rutile; if this is the case a product might be obtained by some method of magnetic concentration, sufficiently free from titanium to be of commercial value. Experiments are now being conducted in order to ascertain the nature of the titaniferous minerals present in the ore."

Sheep River Deposits

During the past year considerable interest and excitement has arisen over the reports which occasionally appeared in newspapers, sometimes the remarks of individuals, and sometimes as news items from sources unknown, that there were enormous deposits of iron situated southwest of Calgary from which unlimited supplies of iron ore could be obtained for smelting purposes. These reports were to a certain extent responsible for the request that this investigation be made on the possible iron supply within the province.

The district referred to lies southwest of Okotoks, along the south fork of Sheep River, in the foothills and also within the front ranges of the Rocky Mountains.

I have gone over the section from the Turner valley west to range 6,and have examined and sampled what was supposed to be the richest beds, and yet it is with regret that I have to report that the grade of ore is most unsatisfactory, as is shown by the accompanying analysis, and also the quantity is insignificant, so that the reports which have been current were entirely unfounded on facts.

There are two localities along the Sheep River to be discussed, where scores of claims have been staked for iron, and some prospecting has been carried out. a number of years ago.

The one locality extends west for about four miles from the junction of Macabee creek and the south fork of Sheep River, about twenty five miles west southwest of Okotoks.

I was given a report which was not signed, but which had been made for a syndicate controlling thirty mining claims in this locality. This report describes the location of the property, and the geology, which is decidedly erroneous. The report states "This property possesses two veins of clay ironstone, one of which measures approximately 400 feet across, aggregating a width of 1,100 feet of vein." An estimate of the ore available is given as 2,400,000,000 tons. It it is also stated that if the ore were mined at the rate of 10,000 tons per day, mining operations could continue for 766 years on this property. An analysis is also given from "Samples taken from the surface," and analysised by the Kingston School of Mines at Kingston. This analysis gives 29.9 per cent. metallic iron in the sample as submitted.

I visited this property in company with Mr. D. B. Dowling of the Geological Survey, who was also interested that such a deposit of iron had been overlooked by various geologists who had previously examined this district. I examined the section, which is well exposed along the Sheep River, also a short tunnel and several open cut prospects. The formation is the Benton shales, the character of which is known throughout the whole of Alberta. There are a few clay ironstone bands, but the widest exposed in the section is shown in Plate 1 and measured about 8 inches. Samples were taken from a tunnel on the north bank of Sheep River, which, when analysed show that the sandy shales cannot even be classed as ferruginous, so low is the content of iron. The following analyses were made by J. A. Kelso, in the Industrial Laboratory at the University of Alberta.

	I.	II.
Metallic Iron	4.55 per cent	4.03 per cent
Silica..	67.86 per cent	70.40 per cent
Alumnia	13.96 per cent	15.16 per cent
Ferric Oxide	6.50 per cent	5.76 per cent
Lime	0.12 per cent	0.12 per cent
Phosphorus	0.01 per cent	0.04 per cent
Sulphur..	0.12 per cent	0.18 per cent

Instead of there being billions of tons of iron ore in this locality, there is not a single ton of rock exposed in this section which would be classed as iron ore.

I wish to emphasise this point, that steps should be taken at once to prevent the circulation of such an erroneous report as mentioned above, which is most detrimental to the industrial welfare of the country when the facts are known.

The other district to which I will refer is situated along Sheep River about 25 miles west of Macabee Creek. A blue print which was given me shows the position of forty-six mining claims which were staked for iron. These claims lie west of the mouth of Gorge Creek. There is a well-exposed section along Sheep River above the mouth of Gorge Creek. I examined the section at a number of points and was accompanied by an interested party, who took me to what were supposed to be the best showings. More time would have been spent on the section if the character of the rock and the indications of iron had been more favorable.

The rocks consists of sandy shales and sandstones interbedded with highly silicious ferruginous bands. Three of these iron bands are shown in one exposure, lying between steeply dipping sandstone. The widest iron band measured forty inches. Samples were taken from a number of the iron bands and three of the besr were analysed by J. A. Kelso at the University of Alberta. The results of these analyses are:—

	I	II	III
	p.c.	p.c.	p.c.
Metallic Iron	7.61	6.19	7.01
Silica	69.20	70.04	68.08
Alumnia	16.34	18.18	13.70
Ferric Oxide	10.88	8.84	10.02
Lime..	0.22	0.32	0.08
Phosphorus	0.02	0.10	0.03
Sulphur	0.08	0.18	0.08

The quantity of ore in these iron bands is commercially unimportant and the analyses show that the quality of the ore is also of no commercial value. Aside from these factors the analyses show that the ore is extremely high in silica and practically free from lime, so that even though the iron content were many times greater, the highly silicious character of the ore would make it almost impossible of treatment in the ordinary blast furnace without concentration The concentration of such an iron rock is not an economic possibility.

Hematite Deposits in Eastern B. C.

The nearest known deposits of iron outside of the province of Alberta are those known as the Bull River and Kitchener deposits in southern British Columbia.

The Bull River deposits occur in the Fort Steele Mining Division, East Kootenay Central railway, between Elko and Fort Steele, twenty miles from Cranbrook and about ten miles north of Jaffray station on the Crow's Nest line of the Canadian Pacific railway. The deposits are situated on the southeast side of Bull River at an elevation of 3,000 feet above the valley.

Leach examined this deposit in 1902 and describes the occurrence as follows:* "The base of the mountain consists of Cambrian quartzites and altered argillites dipping at low angles to the east. Towards the top these are succeeded by dolomites, interbedded with highly altered argillites, apparently conformable with the lower beds and probably also of Cambrian age. In a number of these upper beds the original constituents have been replaced in varying degrees by hematite ore. The work done consists entirely of surface stripping and open cuts, more or less disconnected, so that until further work is done it is impossible to form an opinion as to the continuity of the ore in the several beds, nor was the source of the ore made clear, though it is certain that mineralization has taken place over a considerable area. The ore appears to be of good quality, though in places somewhat silicious. The maximum thickness of clear ore seen was about five feet."

More recent information has been received from Mr. James L. Laidlaw, Mining Engineer at Cranbrook. The property of the Bull River Iron Mines, on which considerable development has been done, is situated at an elevation of 6,500 feet above sea level, and 3,000 feet above the railway at Bull River station. A wagon road leads from the railway to the foot of the mountain, a distance of six miles.

The property in this group consists of eight claims and fractions, about three hundred and seventy-five acres, and crown granted. Development work consists of several open-cuts and short tunnels.

The ore is hematite, and it occurs in bands interbedded with limestone and dolomite which is reported to be Devono-Carboniferous in age. The greatest width of iron band recorded is eight feet, but there are numerous one to four foot bands reported.

Five zones of parallel veins have been noted and can be traced across the entire length of the claims, a distance of 3,500 feet. A typical section of one of these zones is given as follows: —

Ore, 4 feet, containing 55 per cent iron.
Rock, 1 foot.
Ore, 3 feet, containing 35 per cent iron
Rock, 6 inches.
Ore, 1 foot, containing 60 per cent iron
Rock, 1 foot.

An average analysis of the hematite, supplied by Mr. Laidlaw is :—

Metallic Iron	58.99 per cent
Sulphur..	0.026 per cent
Phosphorus	0.029 per cent
Insoluble residue	10.14 per cent

At the foot of the mountain at which the deposits occur in Bull River there are falls capable of developing 12,000 H.P. The nearest coke supply is Fernie, a distance of fifty miles. Limestone for flux occurs close to the deposits.

The Kitchener iron deposits are situated near Cadorna station on the British Columbia Southern railway. A blue print map and a few notes on the deposits were kindly supplied by the Natural Resources Department of the Canadian Pacific railway at Calgary. This map shows over sixty claims and ten fractions. These claims are situated along a narrow zone about eight miles long, which follows a northwest and

*Leach, W. W., Geol. Surv., Can., Ann. Rept., Vol. XV, 1902-3, p. 181 A.

southeast trend between Goat River, just west of Cadorna, and Arrow Creek to the west.

The ore consists of hematite and is found in steep-dipping veins. The widest vein is reported to be about sixteen feet. The country rock is quartzite with intruded by sills of greenstone. Numerous assays have been made on this ore, which are recorded to contain on an average of from fifty-seven to sixty-four per cent iron.

No detailed maps or geological examination have yet been made of these districts, which would indicate the persistence of the ore, although geologists and mining engineers have stated that the quantity of ore and the inaccessibility of the deposits would not warrant development at the present time. Further information is required on these deposits of hematite ore.

Bibliography.

Tyrell, J. B.—Geol. Sur., Can., Ann. Rept., 1886, p. 150 E.

McConnell, R. G.—Geol. Surv., Can., Ann. Rept, Vol. V., 1890-91, p. 63 D. Geol. Surv., Can., Ann. Rept., VOL. XII, 1899, p. 36 R.

Leach, W. W.—Geol. Surv., Can., Ann. Rept., Vol. XV, 1902-3, p. 181 A.

Camsell, C.—Geol. Surv., Can., Ann. Rept, Vol. XVI, 1904, p. 46 CC.

Wait, F. G.—Mines Branch, Dept. of Mines, Can., No. 59, 1909, p. 69.

Dowling, D. B.—Geol. Surv., Can., Sum. Rept., 1910, p. 158.

Leach, W. W.—Geol. Surv., Can., Sum. Rept., 1911, p. 199.

Ells, S. C.—Mines Branch, Dept. of Mines, Can., Sum. Rept., 1914, p. 63.

Camsell, Charles.—Geol. Surv., Can., Memoir 84, 1916.

Alcock, F. J.—Geol. Surv., Sum. Rept., 1916, pp. 154-155.

IRON PRODUCTION AND NICKEL ORE SHOWS LARGE INCREASE IN ONTARIO.

A report just issued by the Ontario Department of Lands, Forests and Mines shows an increase in the value of the output for the first quarter of the present year in metalliferous mines, smelters and refining works of the province, over the corresponding period of last year of nearly a million dollars.

Nickel-Copper.

During the quarter 301,133 tons of ore were raised and 238,700 tons smelted as compared with 229,822 and 226,954 tons respectively for the corresponding period in 1919. Shipments of matte totalling 10,168 tons were made to the refineries in Canada, United States and Great Britain. The British American Nickel Corporation is producing matte at Nickelton and shipping to the refinery at Deschenes, Quebec. The latter is now in operation, although there was no output for the first quarter of the year. A considerable part of the nickel oxide produced at the Port Colborne refinery of the International Nickel Company of Canada is marketed in that form in England. Precious metals—gold, silver, platinum, palladium, rhodium, ruthenium, ismium and iridium—were recovered at Port Colborne.

Iron Ore and Pig Iron.

The Algoma Steel Corporation and Moose Mountain, Limited carried on iron mining, 53,754 tons being raised. No ore, and only a small tonnage of briquettes were shipped.

Seven blast furnaces owned by the Algoma Steel Corporation Canadian Furnace Company and Steel Company of Canada were in operation. These smelted 28,608 tons of Ontario ore (8.8 per cent. of the total) and 295,273 tons of foreign ore, producing therefrom 152,022 tons of pig iron worth $3,897,211. The steel product was 179,244 tons valued at $6,035,308.

THOMAS'S DIRECTORY OF AMERICAN MANUFACTURERS.

The eleventh edition of the Thomas' Register of American Manufacturers, dated January 1920, has just been published, in which more than 300,000 names of United States manufacturers of products classified under over 70,000 headings are listed. It weighs 17 pounds and contains 5,980 advertisements, said to be the largest number of advertisements ever printed in a trade publication.

The register is divided into three main sections with an index totalling 176 pages. The classified section (3,340 pages) furnishes a complete list of the makers of every known United States product, classified according to the article, eleven pages alone being devoted to the single item of acids. A capital rating is also given of each manufacturer, showing the amount of capital invested and the approximate size of the concern. About 800 pages are devoted to two other main sections listing the trade name or brands of manufactured products, and to a continuous list of the names of manufacturers in alphabetical order from A to Z, also giving the addresses of head office, branches, names of officers, etc., of the concerns listed.

Thomas' Register lists all names absolutely free of charge and irrespective of advertising support. The purchasing agent and buyers for nearly 25,000 important business houses use it, several hundred of these being Canadian concerns which find it indispensable when buying United States products.

An international trade section, listing exporters and importers, is included in the eleventh edition, together with a directory of banks, commercial organizations and trade papers in the United States and Canada.

The Thomas' Publishing Company, New York, are represented in Canada by the Canadian Buyers' Register Company, 92 Constance Street, Toronto, from whom specimen pages, etc., can be obtained. The price of Thomas' Register in Canada is $17.50, all charges prepaid.

STANDARD EQUIPMENT & TOOL WORKS, MONTREAL

This Company, directed by Mr. Joseph Presner, has recently acquired showrooms and offices at 307 St. James St., Montreal, and is open to receive catalogues from manufacturers of machine tools and kindred lines. They are also desirous of entering into correspondence with manufacturers of a few good lines with a view to representing them in eastern Canada.

The Toronto Iron Works are engaged at present in building an addition to their plant at the foot of Cherry Street, Toronto. The addition, which will be 100 x 40 feet will be used as a machine and store room and provision has also been made for a wash and luncheon room for the employees. The building is expected to be ready in about two months time.

Company Notes

Toronto.

John T. Hepburn, Ltd., 18 Van Horne Street, Tor-Toronto, has let the contract to Brown and Cooper, Ltd., 297 Carlton Street, for a factory to cost $85,000. and will also start work at once on the erection of a foundry addition.

The Grinnell Co., of Canada, Ltd., has placed a contract with the Anglin-Norcross Co., Ltd., Toronto, for a grey iron foundry in Toronto, 100 x 200 feet Plans have been prepared b ythe H. M. Lane Co., Detroit. The Grinnell Co., which is engaged in the manufacture of fire extinguishing equipment will also place a contract shortly for the erection of a machine shop.

Baldwin's Limited have decided to go ahead with their works on the Toronto Harbor Board's property in Ashbridge's Bay, and Toronto will not lose this promised steel industry because of a shortage of power, this difficulty having been overcome. Baldwin's are already receiving some 1500 H.P. from the Hydro-Electric Co. for their electric furnaces but 10,000 to 15,000 additional horsepower will be required when the works are going at full capacity. It will be at least a year before the new buildings are completed and it is understood that the assurances that their needs will be taken care of, one way or another, have been sufficiently definite to warrant the Company ordering construction to continue. The Company plans to erect three buildings each 800 feet long. One is up as far as the steel work. From 5,000 to 6,000 men will be employed.

The Canadian Radio Corporation, Ltd., Toronto, has been incorporated with a capital stock of $5,000,000 by Sir William McKenzie, Hon. Frederick Nicholls, Abram C. Wisner and others to manufacture electrical machinery, tools, etc.

The MacLean Underfeed Stoker Co., Ltd., Toronto, has been incorporated with a capital stock of $25,000 by John F. Lucas, James S. Duggan, Craig McKay and others to manufacture machinery, tools, boilers, engines, etc.

The Westco Pumps, Ltd., Toronto, has been incorporated with a capital stock of $150,000 by George H. Sedgwick, 36 Toronto Street; John W. Pickup, 255 Glenlake Avenue; James Aitchinson and others to manufacture pumps, pumping equipment, tools, etc.

The United Iron Works and Machine Co., Toronto, has purchased the textile buildings near the Canadian Pacific Railway tracks at Milton, Ont., and will remodel the buildings and install equipment for the manufacture of Orr patent double-piston cylinder engine, machinery, tools, etc.

The Collapsible Tubes and Containers, Ltd., Toronto, has been incorporated with a capital stock of $750,000 by Kenneth S. Zimmerman, 609 Avenue Road; Justin E. Robinson, 583 Avenue Road; Edward J. Swift and others.

The Canadian Trucks, Ltd., Toronto, have been incorporated with a capital stock of $150,000 by Robert B. Burkell, 186 Rusholme Road; Jeremiah W. Curran, Alexander E. Gray and others to manufacture trucks, parts, engines, etc.

The Acton Tool and Stamping Co., Ltd., Toronto, has been incorporated with a capital stock of $100,000 by William B. McPherson, 6 King Street West; Norman S. Caudwell, and others to manufacture machinery, castings, forgings, etc.

The Yeldorb Mfg. Co., Ltd., Toronto, have been incorporated with a capital stock of $1,000,000 by Alvin B. Ruddy, 31 Bloor Street East; Edward J. Syme, Brayton Stinson and others to manufacture separators, agricultural implements, tools, etc.

The Kemp Metal Auto Wheel Co., Ltd., Toronto, has been incorporated with a capital stock of $100,000, by Edward Kemp, Charles H. Ruggles, Robert R. Armstrong and others to manufacture automobile and metal wheels, machinery, parts, etc.

St. Catherines, Ontario.

The Walton-Carlson Co., Limited, have established a new industry in St. Catherines for the manufacture principally of auto accessory tools. They have a plant containing 4,000 square feet of space and started operations on June 1, employing about ten or fifteen hands. They are equipped to do drop forging and stamping work in adition to the manufacture of tools, and have a nickel-plating department to take care of their owr and outside work. The company is capitalized at $40,000, with A. T. Baker, president; W. V. Carlson, vice-president, and S. G. Walton, secretary-treasurer and manager.

Brantford, Ontario.

The Brantford Emery Wheel Co., Ltd., Brantford, Ont., has recently been acquired by interests identical with those of the Waltham Grinding Wheel Co., Waltham, Mass. It is the intention of the new owners to facilitate production and to install new machinery and equipment in the local plant. Frank A. Howard will continue as managing director.

Galt, Ontario.

The Wells Brothers Co. of Canada, Ltd., Galt, Ont., is about to change its name to the Greenfield Tap and Die Corporation of Canada, Ltd., and is also increasing its capital stock from $40,000 to $250,000. The company will shortly increase its manufacturing facilities to more than double the present capacity. Considerable new machinery and equipment will be required.

Hamilton, Ontario.

The Carr Fastener Co. of Canada, Ltd., Hamilton, Ont., has been incorporated with a capital stock of $750,000 by Edward H. Ambrose, Henry A. Burbridge, Arthur B. Turner and others to manufacture castings, forgings, machinery, etc.

Oshawa, Ontario.

The Hugh Park Foundry Co., Ltd., Oshawa, Ont., has been incorporated with a capital stock of $200,000 by Frank A. Park, Oshawa; James Parker, 157 Bay Street; Maurice Crabtree and others of Toronto, to manufacture castings, forgings, tools, etc.

Ayr, Ontario.

The plant of the John Watson Mfg. Co., Ayr, Ont., was damaged by fire to the extent of about $200,000. It manufactured agricultural implements and warehouse trucks, and will probably be rebuilt at once.

Coburg, Ontario.

The Bird-Archer Co. Co. of New York, who have been operating a plant at Coburg for the past three years manufacturing boiler compounds, are extending the scope of their industry. The have acquired the am-

munition plant formerly occupied by the Cohoes Steel Company, Limited. They are transferring their boiler chemical department to the new plant, and expect to have it in operation by July 1. They propose to add the manufacture of high-speed cast-steel tools and foundry chemicals. Production of the former will be commenced by January 1, and of the latter by the end of September. They will probably employ from 50 to 100 hands.

Charlottetown, P. E. Island.

An interesting development in Prince Edward Island at the present time is the enlargement of the plant at Charlottetown of Bruce Stewart and Co., Limited, manufacturers of the "Imperial" line of gasoline engines. In order to meet the increasing demand for these engines, it has been found necessary to erect a new building. This is a fireproof structure 60 x 120 feet. It will be ready for occupation about July 1st, and will about double the company's capacity.

Fort William, Ontario.

The Canadian Iron Foundries, Ltd., Fort William, Ont., has let the general contract to M. H. Bradin and Francis Block, Fort William, Ont., for a foundry addition to cost $20,000.

Winnipeg.

The Home Appliances Mfg. Co., Ltd., Winnipeg, has been incorporated with a capital stock of $250,000, by Arthur E. Cox, John R. Campbell, George F. Chadburn and others, to manufacture washing machines, machinery, tools, etc.

Montreal.

The Northern Electric Co., 121 Shearer Street, Montreal, will build an addition, construction to start at an early date. Mr. Cameron is assistant general manager.

The C. P. H. Gas Engine Co. of Canada, Ltd., Montreal, has been incorporated with a capital stock of $100,000 by Joseph Cepeda, Jean Van der Ghote, Louis Chalvin and others to manufacture engines, motors, machinery, etc.

MERGER AT BRANTFORD.

John H. Hall and Sons, Limited, Link Up With Williams Tool Corporation, Erie, Pa.

John H. Hall & Sons, Limited, Brantford, who are the largest manufacturers of pipe machines in Canada, have merged their business with that of the Williams Tool Corporation of Erie, Pa., who are the largest and one of the oldest manufacturers of pipe machines in the United States, having a capitalization of $1,000,000. The Brantford plant will be known as the Hall plant of the Williams Tool Corporation.

Mr. Leslie S. Hall, president and general manager of John H. Hall & Sons, Limited, when interviewed as to the possible changes the merger would make with the present active members of their company, stated that no radical change would be made in the management; in fact with the American organization coming in the local branch would be in an enviable position as nearly all of the present officers would continue on in executive positions in the new corporation.

Mr. Leslie S. Hall will be vice-president, taking an executive position between the two factories. Mr. A. R. Hall will be manager of the local plant, and Mr. E. L. Williams will have charge of the office. Mr. E. W. Hall is retiring as secretary and treasurer of the company, and Mr. E. L. Hall will no doubt continue with the new corporation on his return from England.

At present the Brantford plant is running to full capacity, and has been operating a night shift for some months past. With the increasing demand for Hall machines, and the prospect of large export orders, it is expected that it will be necessary, in the near future, to vacate the present premises and build a large modern factory elsewhere.

The merger of these two large companies, specializing on pipe machines alone as they now do, will mean much to the machinery houses of Canada and the users of pipe threading machines in general. The new corporation will have a capitalization of one and a quarter million dollars, and the entire activities of the company will be to produce the very latest and best in pipe-threading machines. To the machinery houses this will mean that the present high standard of the Hall product will be maintained and if possible improved. Machines will be manufactured in larger quantities and it is hoped in the near future that the company will be able to make shipment from stock held in their own warehouse. Standard stock parts and dies will be available for immediate shipment.

A special department of the new corporation will be the publicity engineer, or educational department. Attractive literature, covering the various uses of the pipe machine, as seen from the users' standpoint, will be covered, showing charts, diagrams and devices in actual price, the cost of threading pipe, lost production and how to overcome same. For the man on the machine a complete service of instructive and educational circulars, service charts and booklets will be issued, giving the operator the manufacturers' advice and serve of twenty years experience in threading pipe.

Hall & Sons have made many distinctive improvements on the pipe machines, which are all covered by patents, and these, in conjunction with the American company's patents, will cover all the requirements of the pipe threading trade. The company are installing several special, high-powered, modern machines which, they hope will enable them to overcome the continued delay in shipments.

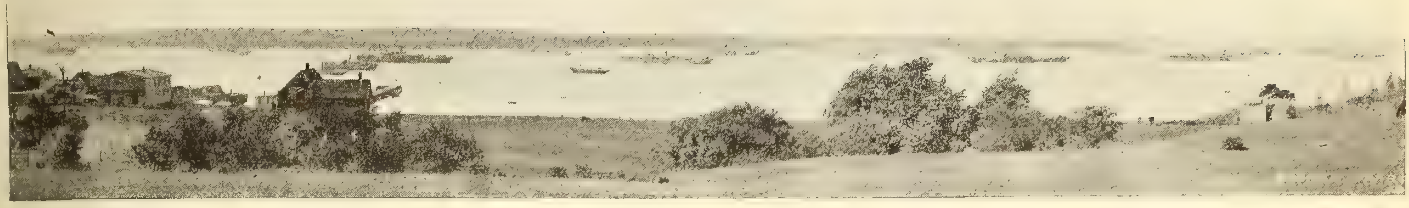
WILL MAKE POCKET KNIVES

Canada Cutlery Co., Limited, Establishes a New Industry in City of Kingston

Ratepayers of Kingston voted favorably on May 19 on a by-law providing for the purchase by the city of the Cereal Works property and its lease for twenty years with option of purchase to C. A. Eaton of Turner's Falls, Mass. It is Mr. Eaton's intention to commence the manufacture of pocket knives, and a company to be known as the Canada Cutlery Co., Limited, will be formed for the purpose. Mr. Eaton, who has for the past fifteen months been works manager of the John Russell Cutlery Co., Turner's Falls, Mass., will be general manager of the company. The company will have an authorized capital of $50,000 of which $35,000 will be issued immediately and the balance as required.

PERSONAL

D. W. Armstrong, formerly with Canada Foundries and Forgings Limited, has been appointed district sales manager, Montreal, for the Dillon Crucible Alloys Ltd., of Welland, Ont.



SHIPBUILDING

GOVERNMENT'S PROPOSAL TO ENCOURAGE SHIPBUILDING CONCURRED IN BY PARLIAMENT.

In support of the Government's proposal to stabilize the shipbuilding industry in Canada, the Minister of Marine, Hon. C. C. Ballantyne said 23,500 men were engaged in steel-shipyards, of whom 25 per cent were returned soldiers, and that from $25,000,000 to $30,000,000 spread over the next three years would be about the extent of the financial assistance which the endorsation of promissory notes for purchasers would require from the Canadian Treasury. The Government's proposal was made largely with a view to securing French orders for ships which the present state of the currency of France would not permit being paid for in cash at this time.

The resolution embodying the Government's plan was supported by members representing constituencies containing shipyards and was opposed by representatives of inland constituencies and members who are on principle opposed to any bonusing of industry either direct or in the form of direct assistance or by tariff protection.

The powers taken by the Government to protect its advances by liens and other security are ample, and, while the necessary temporary financial assistance to tide the shipbuilding concerns over the period of financial reconstruction of those friendly countries from which ship orders are expected is assured by Parliament's ratification of the Government's plan, there is no apparent reason, why in the end, the Treasury should suffer.

As a result of the adoption of the Resolution by Parliament, the continued operation of shipbuilding yards throughout Canada for several years seems assured, by the end of which time it is to be expected that the industry will have experience and stability sufficient to enable it to compete in world markets.

S.S. "CANADIAN WINNER," LAUNCHED AT VICTORIA, V. IS.

On June 29th the Harbor Construction Co. launched the S.S. "Canadian Winner," the first steel ship of her tonnage to be constructed in Vancouver Island. A second ship, the "Canadian Traveller," will be ready for launching at the end of August.

The construction force is composed of returned soldiers and sailors, and it is feared that it will be necessary to dismantle the plant and close down the yard in the Autumn, after the completion of the second ship, as Mr. Charles J. V. Spratt, General Manager of the plant, states there is no possibility of private contracts being obtained because of the exchange rate and the high cost of steel at Victoria. About half the working force will be discharged following the launching, and the remainder cannot be employed after the late Summer. The Victoria newspapers express great dissatisfaction with the decision of the Government not to allot further ship contracts to the Victoria plant, and claim that there was an understanding, to which members of the Government were a party, that work would be continuous in the Harbor Construction Company's plant for at least two years. The Victoria "Times" states editorially: "To the extent the Government is not implementing this promise it is breaking faith."

The "Canadian Winner" is 413 ft., by 52 ft. beam and 31 ft. moulded depth. The engines have been built by John Inglis & Sons, Toronto, and will furnish 3,000 i.h.p. The vessel, like others completed for the Government, is 8,100 tons d.w.

FREIGHTER LAUNCHED AT TORONTO

Saturday, June 19th saw the launching of the seventh ocean freighter to be built in Toronto, when the S.S. "Gonzaba," constructed by the Dominion Shipbuilding and Repair Company, took the water at the foot of Spadina Avenue. The "Gonzaba" is the third ship of a similar type to be built this year. She will carry approximately 2,550 tons of dead weight and is equipped with triple expansion reciprocating engines of 950 horsepower. Her keel was laid last February, and the first week in July she will pull out on her maiden trip to Havana. Following this trip she will enter the trading service in the Gulf of Mexico and South America. A sister ship, the "Florida," is now under construction by the same firm. The ship was christened in the customary way by Miss Abaunza, daughter of Mr. G. Abaunza, President and General Manager of the Gulf Navigation Company, New Orleans, for whose company the ship has been built.

SYDNEY, N.S., A, TRANSATLANTIC PORT OF CALL

The Furness Withy Co. has placed two steamers on the Liverpool, St. John's, Newfoundland, Sydney, Nova Scotia route, and on Dominion Day the S.S. "Sachem" with passengers and freight docked at Sydney. This is the first occasion on which Sydney, N.S., has been used as a regular transatlantic port of call, and the decision of the Furness Withy Co. is probably a reflection of the investment made by English interests in the Dominion Steel Corporation, and the presence of Viscount Furness on the London Advisory Board of the Corporation. On one occasion the "Vir-

ginian" landed mails at North Sydney, the bags being taken off outside the Harbor by the gunboat "Canada." It was popularly supposed that the Allan liner was too large to enter Sydney Harbor, a rumor that made those who knew Sydney Harbor smile, particularly when during the war these vessels visited Sydney as converted cruisers on convoy duty, together with much larger vessels. The Dominion Coal Company on one occasion prepared to coal the "Mauretania" in Sydney Harbor, but the idea was abandoned not because of any difficulty in using Sydney Harbor, but because of the presence of submarines along the coast.

CANADIAN-VICKERS LAUNCH S.S. "CANADIAN VICTOR."

On June 22nd, Mrs. J. W. Norcross christened the latest of the Canadian Government freighters built at the Canadian-Vickers ward at Maisonneuve, namely the S.S. "Canadian Victor."

CHAIRMAN OF CANADIAN COLLIERIES LIMITE MAKES CLEAR STATEMENT ON POSSIBILITY OF IRON INDUSTRY ON VANCOUVER ISLAND

Mr. Henry S. Fleming of New York, Chairman of the Board of Directors of the Canadian Collieries (Dunsmuir) Ltd., is stated by the Victoria newspapers to be investigating the possibility of combining the operation of a moderately sized steel plant with the coal mining operations of his Company. Mr. Fleming is naturally thoroughly acquainted with the resources of Vancouver Island, in which the Canadian Collieries Ltd., has extensive holdings, not only of coal, but of ore and flux bodies and water-powers. In addition Mr. Fleming was formerly associated with steel works in Pennsylvania, and was a special delegate to Ottawa in 1917 on a committee appointed to report on the iron-ore resources of Vancouver Island in 1917.

That Mr. Fleming has accurate and clear ideas regarding the basic requirements of a successful iron industry on Vancouver Island is evident from his remarks, as reported in the Victoria papers, which are in pleasant relief to some ill-informed and foolishly optimistic statements that have been given credence in British Columbia in recent years in connection with the problem of initiating the iron industry that British Columbia so ardently desires.

Mr. Fleming stated there could be no doubt regarding the iron resources of Vancouver Island.

"The magnetic ores which some persons have been decrying make the highest grade steel. We used magnetite in Pennsylvania for the production of steel that was sold at a price above market price.

"The only trouble with the magnetic ores is that with them the furnace capacity is slightly reduced. The ores have to remain longer in the furnace, than do the hematite ores."

The chief side of the steel situation that Mr. Fleming is started out to investigate at once is the marketing possibilities. As far as he can see now, Mr. Fleming says that the coast steel plant would not be able to compete farther East than the middle of the Prairies, with the steel plants at the Soo. He says he even fears the Chicago plants more than the Soo plants, because of their greater efficiency in production.

Marketing Possibilities

The lowest daily production that a steel plant can be worked on is 325 tons. And even this production involves overhead costs which are the same as for plants four times that size.

"Regarding the marketing end the whole thing narrows down to whether 325 tons of steel can be disposed of each day in this territory or produced at a cost that will permit of export," said Mr. Fleming.

Would also Manufacture

"The establishment of a steel plant here means more than the creation and operation of furnaces, although many people seem to believe that is the extent of it all. We will have to establish factories to manufacture the iron and steel as it comes from the mills. As steel rail production is carried on in the east in large quantities and at a low cost, it would be almost impossible for us to compete at first with the Eastern plants in the production of rails.

"Our output then will have to be manufactured into such products as billets, nails, wire fencing, belts and equipments of all kinds. It is likely with the present high freight rates we will be able to hold our market here for such products.

"But my present problem is to find out just how much of these products this territory requires and can absorb."

Mr. Fleming also said that before the steel plant is launched there will have to be assurances from the Government that there will be no eight-hour day restrictions or Sunday laws enforced to cripple the industry as a steel plant must work twenty-four hours a day and seven days a week.

MR. HENRY S. FLEMING

The Worthington Pump and Machinery Corporation announces purchase of the Platt Iron Works, Dayton, Ohio, together with patterns and good-will of the business of making oil extraction machinery, hydraulic turbine and water wheel machinery, and steel containers.

CANADIAN IRON MEN

From C. M. I. Bulletin

MR. GEORGE D. MACDOUGALL.

Mr. George MacDougall was born at St. Peters, C.B., in 1873 where his father John Cameron Macdougall, M.D.C.M., practised as a doctor. After receiving his early education in the public school at Oxford, in Pictou Academy and Dalhousie College, Mr. Macdougall entered McGill University from which he graduated in 1895 with the degree of B.A.Sc (with honours) in Mechanical Engineering.

Since that time Mr. Macdougall has had a wide and varied experience in mechanical engineering both in Canada and the United States. Beginning with the Robb Engineering Company at Amherst, N.S., he afterwards went across the line, and was engaged in shop

MR. GEO. D. MACDOUGALL

and engineering work for the G. F. Blake manufacturing Company, of East Cambridge, until 1898. For next year he was chief draftsman on marine engineering for the Fore River Ship and Engine Company, Weymouth, and later was in charge of power-house design and erection with the Edison Illuminating Company of Boston.

In 1900 he accepted a position with the Dominion Iron and Steel Company as master mechanic and assistant manager of ore mines at Wabana, Nfld., but returned to the United States at the end of 1901 to become assistant chief engineer for the Lackawanna Steel Company, Buffalo, and later mechanical superintendent. From 1904 to 1909 he was with the Dominion Iron and Steel Company at Sydney, N.S., two years as mechanical superintendent and three as chief engineer, following which he was Superintendent of construcetion for the Canada Iron Corporation at Midland, Ontario. At the beginning of 1911 he returned to the Dominion Iron and Steel Company as mechanical superintendent, and in 1916 became assistant general superintendent in charge of the engineering and mechanical departments, retaining this position until he accepted, in 1918, his present position of general superintendent of the Nova Scotia Steel Company, Ltd., New Glasgow, N.S.

Mr. Macdougall is 1st Vice-President of the Mining Society of Nova Scotia, President of the Nova Scotia Accident Prevention Association and was recently elected Vice-President of the Institute. He is also a member of the West of Scotland Iron and Steel Institute,, the Engineering Institute of Canada, the American Iron and Steel Institute, the American Society of Mechanical Engineers, etc.

NEW USE FOR ELECTRIC FURNACES.

Electric ferroalloy furnaces have been diverted to a most interesting use commercially. A Southern company, which made synthetic pig iron, ferro-manganese, ferrosilicon and other similar products during the war in its electric furnaces, found itself after the armistice with the problem of finding a profitable use for its equipment. Prices for ferro-manganese and low-phosphorus pig iron had declined and in the production of certain other alloys there was keen competition. The result of wide investigations has been the manufacture in this type of furnace of phosphoric acid and potash on a fairly large scale. For making phosphoric acid, phosphate rock is smelted in the electric furnace and the phosphorus driven off as phosphoric oxide, suspended in the gases. These are collected and treated by the Cottrell electric precipitation system in which the phosphorus compounds are collected electrically as a fine powder. By further treatment and concentration a superior product is obtained, free from many of the impurities which are present when sulphuric acid is the disintegrating agent.

In the manufacture of potash, Southern shales are similarly treated with the formation of oxides of potassium in the gases and their electrical precipitation and collection.

The substitution of electricity for expensive chemicals in these interesting cases is not only a feature of this new practice, but there is the other novelty that electricity is used both as the destroying or breaking-down agent and as the medium by which the final products are removed.—"Iron Age."

James C. Blair, Toronto manger for Alfred Herbert, Limited, of Coventry England, manufacturers of machine tools and supplies, is about to open a showroom at Nos. 1 and 3 Jarvis street, Toronto, which will be ready about the middle of July. A representative stock of turet and capstan lathes, milling and drilling machines, etc., will be carried and demonstrated at the showroom, which will be devoted to a display of the Alfred Herbert, Ltd., goods. The firm have issued an excellent publication entitled "Cutting Tools" which they are sending to those interested. The office is in the Board of Trade Building, Yonge Street.

BOOK REVIEW

TECHNICAL WRITING. By T. A. Rickard, Editor of "Mining and Scientific Press." First edition. John Wiley & Son, New York and Chapman & Hall, London. 178 pages with index. Buckram Boards. $1.50 net.

Those who have read Mr. Rickard's previous work, "A Guide to Technical Writing," will need no introduction to his abilities to point out the frequent faults of technical writing, a subject which, as the editor of a technical publication, must be constantly before him. "This little book" states Mr. Rickard in his preface, "has grown from a set of five lectures delivered before the engineering classes of the University of California in 1916. It is a ticklish task to write on writing because the effort provokes self-consciousness. All I hope to accomplish by means of these printed lectures is to cause members of my former profession to 'sit up and take notice.' " We believe Mr. Rickard can claim to be master of two professions.

As a writer, Mr. Rickard is well qualified to advise on style, having himself developed one of the most lucid and readable styles in contemporary techincal literature. A mode of expression such as that employed by Mr. Rickards is not, however one that can be easily come by, and it will be admitted by those who have any experience of writing that what is apparently the happy and spontaneous expression of the moment is in reality the outcome of much reading, much experience, much labor, and a thorough knowledge of the subject written about. Those who have had occasion to look over the papers of students and immature writers will have noticed that half assimilated and incomplete knowledge leads to a turgidity that no amount of use of technical terms will help to clear, and, conversely, the speeches of eminent scientists, who thoroughly comprehend their subject, are remarkable for their simplicity of wording and the clearness with which the idea they discuss are presented to the reader.

One of Mr. Rickard's happiest essays dealt with the romance of mining, and was doubtless much appreciated by the International Mining Convention before which it was delivered recently at Seattle, but this essay could not have been undertaken without wide knowledge, and revealed an acquaintance with literature, old and new, sacred and profane, that is attained by few technical writers. While, therefore, the attainment of Mr. Rickard's own felicity of expression is only possible to those, who in addition to the ability to think clearly and the possession of accurate technical knowledge, are deeply read and possess more than an ordinary education in English, there is a widespread necessity existing among engineering students to improve their use of English as an instrument to convey technical knowledge to others.

Mr. Rickard's slogan is "Remember the reader," which he correctly terms the fundamental rule of writing. "Somebody must put hard work into every technical article that is written for publication, if not the author, then the editor; if both the author and the editor shirk their duty, the reader will have a headache."

A quotation from Quintillian by Hill is used by Mr. Rickard, to emphasise the necessity for clearness, that is very apt. "It is not enough to use language that may be understood; it is necessary to use language that must be understood."

"Superlatives and other Diluents," is a chapter touching a common fault of writers. "Diluent" is a delicious sarcasm. The word "very" it is stated can be deleted nine times out of ten. The qualification of the unqualifiable word "unique" is properly condemned. "Considerable" is described as "a woolly word, usually out of place in a technical statement." Such loose and indefinite terms as " more or less," "some," "greater or less extent," "more or less completely" are shown to be a source of weakness. "The secret of a vigorous style is the rejection of the superfluous word" is Mr. Rickard's conclusion. At the same time he shows that clearness is desirable even if it requires seeming tautology.

A helpful chapter is that on hyphens and compound words, the trend of which is to be seen from the following examples :

"A 'single stamp-mill' is a lonesome mill.

" 'A single-stamp mill' is a mill consisting of batteries of one stamp each.

"A 'single-stamp-mill is a mill containing only one stamp.

"A 'crude ore-bin' is an ore-bin of crude construction.

"A 'crude-ore bin' is a bin made to contain crude ore.

" A 'crude ore bin' is an example of crude writing."

In the chapter of "slovenliness" Mr. Rickard criticises, not too hotly, the befouling of the English language with vulgarisms and colloquialisms that are understood only locally or regionally. "Chucking muck in the gob" may be a phrase understood in Yorkshire coal-mines, but it is not preferable to "packing the waste," a term that does permit of ambiguity.

"Jargon" is dealt with entertainingly but in a root and branch fashion. It is described as dealing in periphrases rather than going straight to the point, it loves the abstract rather than the concrete, it dabbles in words of sound rather than meaning." Sir Arthur Quiller-Couch is quoted as writing; "In literature as in life he makes himself felt who not only calls a spade a spade, but has the pluck to double spades and re-double."

We think Mr. Rickard's truest statement is that slovenly writing is the result of slovenly thinking, "for slovenly habits of expression corrode the very substance of thought." A notable quotation is given from Whewell, who in the "Philosophy of the Inductive Sciences" writes: "Language is often called an instrument of thought, but it is also the nutriment of thought; or rather it is the amosphere in which thought lives; a medium essential to the activity of speculative powers, although invisible and imperceptible in its operation, and an element modifying, by its qualities and changes, the growth and complexion of the faculties which it feeds."

Mr. Rickard's little book is commended to all who desire that their writing shall clearly express the thoughts they desire to communicate. While not all can hope to attain to the ideal of language expressed by Mr. Rickard in the concluding sentence of his book, it is here quoted as a fine example both of style and idealism. "Language is a factor in the evolution of the race and an instrument that works for ethical progress—it is a gift to be cherished as the ladder by which man has climbed from his bestial origin and by which he may ascend to a loftier destiny, in which,

ceasing to stammer in accents that are but the halting expression of swift thought, he shall unfold his mind in the fulness of speech, and, neither withholding what he wants to say nor saying what he wants to withhold, shall be linked to his fellows by a perfect communion of ideas." F.W.G.

BENEFICIATION OF LOW-GRADE ORES ON THE MINNESOTA RANGES SUGGESTS SIMILAR UTILISATION OF ONTARIO ORES.

(By J. J. O'CONNOR.)

The prophetic vision of iron-ore operators of the Minnesota ranges, in meeting and mastering the problems of beneficiating the immense quantities of low-grade ores, will enable these ranges to hold out a supply of iron ore, far into the future, after the present known high-grade ores are exhausted.

All over the central portion of the Mesabi, are almost unlimited quantities of low-grade ore, a few points in iron below what the furnaces today can handle at a profit.

The washable ores are in great quantity and are already being washed up to commercial grades by millions of tons per year.

The eastern end of the Mesabi has great low grade deposits of magnetic ore, for the handling of which, a process has been worked out, at a cost of half a million dollars actually expended.

The Vermillion range has large deposits of banded jasper, streaks of ore, separated by bands of jasper and silica.

Minnesota's high-grade ores have enabled her to gain a commanding position in the iron-producing world. Her iron-ore operators are far sighted enough to prepare for the successful holding of the lead she now enjoys, as the greatest iron producer in the world, by lending their money and talent in devising ways for the beneficiating of her low-grade ores.

When Judge Gary of the United States Steel Corporation was in Duluth, Minn. in January 1918, he said: "Within this state are billions of tons of iron ore not now considered of any market value whatevr, which some day will be valuable and which may be used practically and profitably for conversion into iron and steel. And it will be hundreds of years before this ore is exhausted."

The conditions obtaining on the Minnesota ranges, are almost exactly duplicated on the northern Ontario ranges. Judge Gary's terms may be easily applied, and with equal truthfulness, to the Ontario ranges, where the quantity, grade and variety of ores are repeated on range after range to an almost unlimited extent, all susceptible of some form of treatment to bring them to merchantable grades.

No one process or scheme can be devised to beneficiate all kinds coming under the head of lean ores. Each variety requires separate treatment, at varying costs.

The work done by the Hayden-Stone interests (Mesabi Iron Company) upon ore already magnetic by nature, makes the problem of handling non-magnetic ores very much easier. A non-magnetic ore can be converted into a magnetic ore by giving it a magnetic roast. That is to say, if a small percentage of coal or coke, or even peat, be mixed with a non-magnetic iron ore, and the mixture then heated in a suitable furnace, to a suitable temperature, under suitable conditions, the ore become magnetic.

The muskeg and peat beds of northern Ontario, together with the enormous hydro development possible in the territory, would solve the fuel and power problem of any such undertaking on Ontario ranges. The preparation and production of peat for this purpose, has as great possibilities in it, as has any scheme for briquetting it, and selling it in competition with coal.

The day is not far distant when Canada must look to its own sources for a supply, of at least a very large percentage, of its iron ore requirements, if not for the whole tonnage charged to Ontario furnaces. Everything points to an increasing demand for iron ore throughout the continent. This demand will be lasting, and so increase the consumption of United States Lake Superior ores, that, in justice to themselves, they will be obliged to curtail the export of their high-grade ores.

It would, therefore, seem to be a fitting time for the Government to give the necessary encouragement to capital to invest in the development of our enormous deposits of iron ore and be ready for the day that they must be used, and may be our only depenence.

Everything that is being done on the Minnesota ranges in the way of beneficiating lean ores, can be repeated here in Ontario. All it needs is Government encouragement, to induce capital to invest in this greatest of all industrial enterprises. There never has been a time in the history of Canada, when the conversion of this great natural resource into an active element of progress, as the present. There never has been a time when so much interest has been shown by her public men, or such keen sympathy felt for a step of this kind. All agree, that anything that will bring about the rational development of our natural resources, must be in the general interest of Canada, and of the whole people.

It must not be forgotten, that the only chance the Government would be taking, would be the cost of the legislation. If the passing of this legislation did not bring about the industrial development of our iron ores, it would not be called upon for any outlay by way of aid. With the development it would be certain to cause, the advantage to Canada would be Canada would be immeasurable.

PROJECTED BLAST FURNACE AND STEEL ROLLING MILLS FOR SEATTLE, WASH.

"Iron Age" is authority for the statement that a steel plant is projected for Seattle, a matter of interest to British Columbia, in view of the announced policy of the provincial government to bring about the construction of a steel plant in that province.

It is announced that the Western Rolling Mills Corporation, of Seattle, has purchased a contract of 63 acres in the southern city limits, on which will be erected the first unit of a plant for the manufacture of steel and steel products. The cite acquired has a 30-ft. right of way from the plant location to the Duwamish Waterway, giving the company transportation by both rail and water. The first unit of the plant to be built will cost about $1,000,000, while plans prepared for the completed plant, with blast furnaces

at the mines and all equipment, represent an outlay of approximately $15,000,000.

The initial unit of the company, work on which will proceed immediately, will consist of one electric furnace and one open-hearth furnace, but buildings sufficient to house the completed steel plant will be erected at this time. These structures will include three buildings paralleling each other adjacent to the railroad tracks, the mill building to be 540 x 85 feet. Adjoining it will be two smaller buildings one 240 x 50 ft., and the other 250 x 50 ft. The first unit will have a capacity of 50 to 100 tons daily, and will employ about 300 men. All machinery and equipment in the plant will be electrically driven.

The later units to be constructed will provide an output of 300 to 500 tons daily, and will include a merchant bar rolling mill, consisting of three open-hearth furnaces; two ingot continuous furnaces, one billet continuous furnace, one breakdown mill, 12-in. merchant mill, electric conveyors, machine shop and electric furnaces for special steel.

The company has control of hematite ore deposits near Bellingham, Wash., estimated to contain 100,000,000 tons of ore, and of ore deposits in British Columbia of almost equal value.

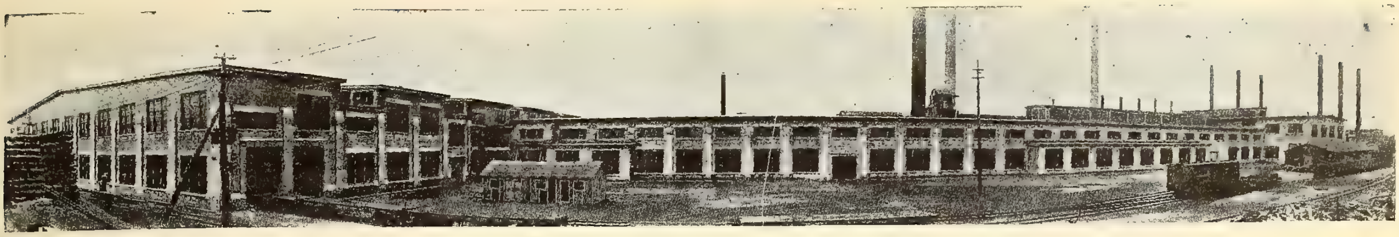
The company is headed by J. Johnson, president, an experienced steel man, who obtained his knowledge and working experience in steel at the Riga Iron Works, Riga, Russia, and who has been employed in steel plants of Germany and Switzerland. J. M. Price is vice-president and Frederick Bruhn is secretary-treasurer of the concern. City offices are now maintained at 401-403 Pacific Block.

The company expresses the conviction that Seattle as a geographic location has a distinct advantage over other locations, and points to the fact that steel and steel products alone exported from the Port of Seattle last year approximated $37,000,000. Officials of the company declare that on Japanese importer has offered to contract for the entire output of the mill for six months if date of delievery can be guaranteed.

The Report of the Factories Inspector for Nova Scotia refers to disappointing results of the appointment of safety inspectors in industrial establishments in the Province, and states: "The men appointed as safety engineers were in each case good reliable men, "thoroughly in earnest, and at the outset determined "to make good on the job. One of the engineers, who "was an expert with previous experience in the United "States, finding that he did not receive proper support "or encouragement from these higher up, resigned, "saying that he could not afford to waste his time, "the position of these men was not given prominence, "they had no influence with the heads of departments, "and even ordinary foremen could ignore their suggestions."

Safety propaganda is difficult to direct from the top. It has to proceed from the ground up, and before any useful work can be accomplished it is necessary that both workmen and foremen must be convinced of the necessity for safety measures, otherwise they will oppose passive if not active resistance to any innovation of the "safety first" man, who, as the Inspector laments, is far from being taken seriously in many plants.

Labor politics in Australia seem to be accompanied by much bitterness. The "Industrial Australian and Mining Standard" last to hand contains a sardonic cartoon, in which a gentleman of the traditional "capitalist" type as portrayed in American lampoons, is shown addressing an audience of apparent jailbirds as follows:—"Now boys, I will put the motion, Hands "up the b...... scabs and traitors who want to continue doing a fair day's work for a fair day's pay. "Thank you, boys, not a single hand raised: I declare "the resolution to strike carried unanimously."



EDITORIAL

Transportation Routes are Undergoing Re-Alignment

A re-alignment of transportation routes in North America is assuming definite shape, some of the causes being undeveloped, and as yet not clear, and other causes more apparent.

The more general use of the Panama Canal is following upon the great port improvements on the Pacific Coast, Seattle having taken the lead and reaped the initial benefits of its expenditures, with Vancouver not far behind. More and more does it seem likely that the trade of the Orient will flow towards the Pacific ports, and that Vancouver will increase in importance and volume of shipping interchange. The growing strength of Japan, and the commercial impetus and increase in population which is likely to follow her occupation and administration of Eastern Siberia, Manchuria, Sakhalin, Corea, and the long heralded renaissance of China, which seems likely to take place under Japanese tutelage forecast much coming enlargement of the commerce of the Northern Pacific. The political changes which these future developments may give rise to are momentous and may force some re-adjustment of the attitude of North America towards Japanese and Chinese ambitions, but they point indubitably towards greater importance of the Pacific ports and the railway lines that serve them. The presence in China of great deposits of anthracite, bituminous coal, iron and alloy metals, is one of the significant facts indicating world destinies.

The great bituminous coal reserve of Canada lies bordering the crest and to a great extent on the Albertan side of the Rockies. This deposit is so large and unique in Canada that it must at some future date become the dominating centre of Canadian industry, and the focus from which transportation lines will radiate. Inspection of the map will show that the western coalfield is relatively near to the Pacific Coast, and that in days to come Vancouver will become a great coal-exporting port, and the point from which manufactured articles, made with the assistance of western coal will go out.

The recent conferences on the St. Lawrence waterway indicate quite unmistakably that the future will see ocean-going vessels going to Duluth and Port Arthur, which will not displant but will supplement the existing east to west rail lines, and others that are yet to be built. Such a route will mitigate those seasonal crises in transportation which the periodical accumulation of crops combined with climatic conditions must always cause in North America, and it will be time to talk about redundance of transportation facilities and competition of facilities when it shall be demonstrated that existing routes are adequate. Most people will be of the opinion that their complete inadequacy has been proven.

From the viewpoint of the coal and steel industries of Canada, the importance of the St. Lawrence waterway—should its possibility be favorably reported upon by the engineers who are studying it—is that it will enable Nova Scotian coal and Newfoundland ore to be brought to steel plants and metal-working establishments in Ontario and Quebec, and thereby lessen a dependency upon our neighbors that has become a national menace.

There is the further consideration that the northwestern states of the Union are about as dependent upon British Columbia and Alberta for bituminous coal as Ontario is upon United States sources of supply. Quebec cannot be said to be dependent upon the United States for bituminous coal, as there is an amply sufficient potential source of supply in Nova Scotia, and the St. Lawrence waterway has for many years carried millions of tons annually from Nova Scotia to Quebec centres of consumption. When the coal fields of Alberta and British Columbia become the main source of bituminous coal supply along the Pacific coast the international exchange of coal between Canada and the United States will not be so humiliatingly lop-sided as is the case now.

There seems therefore emerging from today's readjustments a possibility that at some point in the Canadian West, perhaps not far from the Saskatchewan-Albertan border, there will be discernible the "water-shed" of traffic, from which on one side the stream will flow to the Pacific ports, and on the other side to the Atlantic ports of the Dominion. The shipment of manufactured articles from the East to the three provinces of Saskatchewan, Alberta and British Columbia will lessen as the coalfields provide a domes-

tic source of articles that now originate so largely in the East, and to the southwards, and instead of being exporters of wheat and beef, and importers of mostly everything else, the prairie provinces and British Columbia will become exporters of manufactured articles, in addition to agricultural products, and importers of very little.

The one drawback to industrial eminence in the prairie provinces is the apparent lack of an iron-ore deposit. It is a little too soon, however, to assume that such a deposit may not yet be discovered within transportable range of the western coalfields. In Briish Columbia this difficulty is not so marked, and, on Vancouver Island, the necessary conditions for iron smelting and steel manufacture seem to be present.

The inadequacy of rail transportation in North America is generally admitted at this time, and whether it is a breakdown of executive or operating conditions, or simply a reflex of social adjustments, it is difficult to form an opinion, but it is probably a combination of them all. Leaving this aside, the condition of rail transportation is causing much speculation on modes of improvement, prominent among which are proposals of electrification of steam roads, and long-distance motor-truck transportation, which is becoming more and more feasible with improvements of highways and truck design. It appears very likely that much development in both these directions will take place in the immediate future. The marked increase in motor manufactures in Canada shows that our manufacturers are reading the signs of the times, and this field has many possibilities in Canada, and is of interest to the steel trade in particular.

Interchurch Report on the U.S. Steel Strike

The Interchurch Report on the steel strike in the United States is a disturbing document, but it is not judicial in its statements, nor is it helpful in its recommendations. It makes its main attack on the twelve-hour day and the seven-day week employment that is admittedly the most vulnerable condition attaching to the steel industry. The leaders of the steel industry are, and have long been seeking a condition which, as Mr. Gary has stated, the United States Steel Corporation would be glad to accept "for the reason, if for no other, that we think there is a strong public sentiment in favor of it." "The Iron Age," commenting editorially on the Report, states: "That part of the Report relating to the twelve-hour "day and seven-day week, alhough covering familiar "ground to a large extent, is worthy of the careful "consideration of all employers. Progress has been "made in reducing hours of work, and more ought to "be done, and we believe will be done without un- "necessary delay." If it should be that the division of continuous process employment into two shifts covering each twenty-four hours meets with the universal condemnation of the workmen thus employed, and is found to be unique in application to the steel industry, the practice will not survive, but neither of these conditions have as yet been established.

The practicability of the only alternative to the twelve-hour shift, namely a three-shift eight-hour day, is not established by such an astonishing paragraph in the Report as the following:

"But the decisive factor, setting aside all consider- "ation of the moral questions involved in the twelve- "hour day, and in "suggestions of flooding the steel "industry with Balkan immigrants or coolie labor, "lies in this consideration, which, according to en- "gineers, disposes of the labor-shortage argument "against the eight-hour day; the steel requirements of "the country could be met by utilizing all the first- "class machinery, scrapping the rest, and distributing "the work throughout the year on a three-shift eight- "hour day basis." Such a counsel of perfection would require the combination of omniscience and omnipotence, and where shall it be found?

Another paragraph of the Report runs:

"Engineers' findings are: That the steel industry "being run for the making of profit, and not prim- "arily for the making of steel as the country needs "it, favors (a) spells of idleness during which the "country and the steel workers pay for the mainten- "ance cf idle machinery, and later (b) spurts of long- hour, high-speed labor."

This is in effect an indictment of human society as it exists, and attempts to fasten upon the leaders of the steel industry single responsibility for economic disturbances which are the joint responsibility of society. To assume that alternate cycles of trade depression and prosperity are the result of deliberate action by any one group of industrialists reveals such unsound thinking that it vitiates any useful purpose the Report may serve, and counsels caution in accepting even such of the recommendations of the Report as will not be generally disagreed with.

Te Report explains the failure of the strike under a number of heads, but one of them seems all-sufficient, namely: "Public fear of a general labor war "due to the coincidence of the coal strike, and the "threat of the railroad strike, together with labor's "failure to formulate and explain its purpose with "regard to public service." Much depends on the interpretation of the word "coincidence." The generally unfavorable attitude of the public and the authorities towards the strike was based on fear and

distrust of the mysterious forces that seemed to be combining to destroy public service. The Report does not show that this general fear was ill-founded, and subsequent revelations have convinced the public of the United States that the administration was justified in the measures it took to safeguard the American public last year.

It is a pity that so altruistic a document as the Interchurch Report, coming as it does from a source that compels attention and a respectful hearing, was not more judicially framed, because it calls attention to conditions that require remedy, and can be remedied only by the joint labors of the employers and the workmen. The Report is too unsparingly condemnatory, and does not give any credit to those employers that have endeavoured to ameliorate the living conditions of steel employees, while stabilizing the financial condition of the industry.

FREIGHT INCREASES WILL HIT BASIC COMMODITIES.

A number of the United States' financial newspapers are suggesting that the increase in railway freight rates recently authorised will not materially increase the cost of commodities, and, as an example, it is calculated that the freight on a $60 suit of clothes might be increased three cents thereby.

It is not the freight cost of manufactured articles that is most affected by an increase in rail freights. It is the heavy basic commodities that will suffer most, such as coal, iron-ore, petroleum and wheat. The cost of coal to the manufacturer will be increased by the freight advance, and every manufactured product into which coal enters will be increased in progressive ratio at each stage of manufacture and handling. The manufactured products into which coal enters covers the whole list, with entirely negligible exceptions.

SLAG BY-PRODUCTS.

It is announced from Sydney that the Dominion Steel Corporation has taken over and will operate the plant of the Sydney Cement Company, which has been idle since the commencement of the war. This plant made cement from the granulated blast furnace slag produced at the Steel Works, and also a cement brick, used in the construction of the Sydney offices of the Steel Corporation and quite extensively in the erection of colliery buildings during the period from 1910 to 1914. In this connection we would call attention to the paper on "Iron Portland Cement" which appears in this issue. The history of slag cement in Nova Scotia was similar to that mentioned by the writer of this paper, and during the war a project was mooted to make an improved cement at the Sydney Works, but fell through owing to lack of capital and slack demand for building materials.

The Dominion Steel Corporation owns all the raw materials necessary to produce a reliable cement, and while no doubt a large field for cement and bricks will be found in the Corporation's own construction campaign, it should be possible to develop this local industry to fill a larger field, and make profitable use of a waste product to a partial extent.

The Dominion Steel Corporation also has acquired a silica deposit at Whycocomagh, Cape Breton, and proposes to make refractory products for use in its metallurgical and coal-coking processes.

In addition, this company can produce from the shales and marls overlying its coal seams, any desired quantity of ordinary red and buff building bricks and tiles.

As a producer of slag and tar products, this Corporation could also, if desired, provide a roadmaking aggregate such as forms a valuable by-product of many European concerns having similar operations.

As a miner and manufacturer of structural and roadmaking materials the Dominion Steel Corporation would have many possibilities, should the population and wealth of Nova Scotia increase sufficiently to warrant excursions into these untouched fields.

THE BRITISH COLUMBIA STEEL PROJECT.

The Minister of Mines for British Columbia is a gentleman that realises to the full the responsibilities of his office, and is most energetic in discharging them, and in no instance has he been more properly insistent than upon the advantages to British Columbia of an iron and steel plant situated in the province. At the recently held Mining Convention in Nelson, Mr. Sloan referred to the British Empire Steel Corporation and asked whether the formation of this important corporation would hasten or delay the coming of a steel plant to British Columbia.

Mr. Sloan, in asking this question, which would never occur to an Easterner, reflects a feeling that is surprisingly common in the West, namely, that in some unexplained and occult way the eastern steel companies are possessed of power to influence the attempts of provincial interests to commence domestic manufacture of iron and steel goods. We believe that from the Canadian viewpoint eastern steel men would wish the West all kinds of luck in such a venture; and that from the strictly business standpoint, the eastern steel mills are not tremendously interested. It is not competition from the Canadian East that a British Columbia plant would have to meet, but from Chicago, and other midwestern United States centres.

The most satisfactory feature about the present discussion of steel plant possibilities in British Columbia is that it is being looked into by capable persons, with actual metallurgical knowledge, and perhaps we shall hear no more of the wierd traditions that British Columbia magnetites are so constituted as to be irre-

ducible in the blast furnace, because the melting point of magnetite is higher than the possible temperature of the blast furnace, as was gravely urged at the Canadian Mining Institute Meeting in Vancouver last autumn.

If the iron and steel industry takes root in British Columbia it will be because in that province there exists coking coal, iron-ore, fluxes, maritime location and a market. The demonstration of the obvious possibilities of this combination rests with the people of British Columbia alone.

BENEFICIATION OF LOW-GRADE IRON-ORES.

The abstract of Bulletin No. 7 of the University of Minnesota's School of Mines Experimental Station, dealing with the lengthening of the producing life of the Lake Superior District by utilization of the lower-grade ores that are so plentifully present, has much bearing upon the value of similar occurrences in Canada, particularly on the North Shore of Lake Superior. Those who are beginning to ascertain with that definiteness that can only come from large scale operations just what value the lower-grade ores possess are to be congratulated on the commencement of their work before the so-called merchantable ores have been exhausted. Iron-ores and coal are two commodities whose value is always relative to their availability. The commercial success of concentration of lean iron-ores south of Lake Superior will be watched with keen interest by Canada, for nature has not given us an over-supply of iron ore in such parts of the country as are best known and are most accessible.

LENIN ON THE INTELLECTUALS AND THE ENGINEER.

The "Social-Demokraten" of May 14th, reports a conversation between Jakob Friis, a noted Norwegian socialist and Lenin. The proletarian autocrat is described as having brown eyes, "with a little touch of red." "He is a little deaf in one ear, and therefore talks loudly. When he wishes to bring out an important point, he closes one eye while he thinks, and at the same time a knowing smile comes over his face." There is no trace of humor in Friis's account of this engaging personality with the pensive wink, for he describes Lenin's doorway as the "entrance to the Holy of Holies," and remarks "one never for a moment notices Lenin being conscious of his own greatness. So great is he." Lenin criticises the intellectual doubters who "confuse the mass of workers." "Can you demand," asks Friis, "the same revolutionary clarity in other countries as in Russia?" "Ah!" replies Lenin, "the *war* has been such a teacher."

After further conversation, during which master and disciple discuss murder, revolution and the destruction of the fabric of society as it now exists in the academic and detached way that takes away the breath of the unitiated, Lenin expresses himself thus:

> "Revolution is coming unavoidably in every country. But it will be probably easier in the countries of Western Europe than with us. There they have entirely different organized forces in their hands than we have. Temporarily Russia has taken the lead. But when the revolution is over in Western Europe, Russia will quickly lag behind in development. How is it with the intellectuals in Norway, are they strongly reactionary?"
>
> "They have become better recently. Especially the French *Clarté* movement has awakened much interest. When the French authors begin to be Bolshevist the Norwegian authors will follow close behind them."
>
> "Hm. I don't suppose that such a following of the fashions is much to trust to."
>
> "Perhaps not, but at least among the engineers I think that there is a real important movement discernible."
>
> "Yes, they are more or less on our side everywhere. In Germany there is almost an engineers' proletariat, so to speak. It is of the greatest importance to get the engineers on our side. In this country they had, for the most part, purely capitalistic interests. It will also require many years to build up industrial life here anew. It is to be hoped that you will have an easier time of it in Norway."
>
> Lenin looked at the clock. I got up and thanked him for all his kindness to me during my stay in Moscow."

We live in difficult times, and world currents are moving, the origin of which is not always known to those who are carried along by them. An "engineers' proletariat" strikes us as a phrase of evil omen, proceeding from an evil source. Should the engineer abandon the traditions of service, and those constructive ideals that have placed him in the forefront of progress and all that pertains to the welfare of mankind, and run after the strange gods of selfishness and greed, and consort with those who have adopted as the war-cry the equivalents of "More and still more" and "Ourselves alone," there would be little hope for the world. The entrance of the engineer into political life has been a significant event of recent years, and we believe that, if the best minds of the profession realize their responsibility and do not hold aloof from a duty of citizenship that is innately repugnant to the scientific engineer, the political influence of the engineer will be a cleansing and stabilizing element in the melting-pot of North America. There is just a danger, however, that minor and inferior elements in the profession, if not dominated by its intellectual leaders, may stray into the wilderness of chaotic thinking that has engulfed so many at this date, and has not by any means run its epidemic course.

SIR JOHN WILLISON ON THE OUTLOOK FOR CANADA.

Sir John Willison recently delivered before the Canadian Club at Halifax an address on the outlook for Canada in which he strikingly expounded the necessity to turn our raw materials into finished products in Canada. "Those who have ears to hear, let them hear," says Sir John, "for surely there is no other "national policy for the Canadian people, whatever "may be the fiscal faith which they have inherited, "or the economic creed which they profess. It would "be a blessing of the gods for Canada if we could for- "get that we ever had a tariff controversy and if we "could approach the questions that are vital to national "unity, national expansion and national prosperity "without the fettering and narrowing incubus of old "racial quarrels and party animosities. Through war, "the debt upon the estate has been increased from "$336,000,000 to $2,000,000,000, and if we are to re- "duce the obligation we must maintain and expand "the industrial fabric and conserve and develop the "natural resources."

"During the four years of war the half of our "population which was not engaged in agriculture "carried $83,379,099 of the war taxation, while the "half engaged in agriculture carried $389,011—or on- "ly half of one percent. In this comparison I am not "making any covert attack upon the farmers."—and here Sir John makes what we conceive to be his main point—"but only emphasising the heavy con- "tribution of finance and industry and suggesting the "heavier burden which must fall upon agriculture "and industrial workers if these special sources of "taxation should be restricted or destroyed...... We "get only one-tenth of the value of natural resources "if they are exported for manufacture in other "countries."

We believe that the single vision which arises from the unrelieved and therefore necessarily selfish dominance of agriculture is gradually being enlarged as the peaceful penetration of agricultural communities by manufacturers proceeds in the West. One has only to glance over the provincial incorporations to see how persistent is this expansion, nor does it require great perspicacity to realize that the capital accumulation of many wealthy agriculturists is arousing a desire to have this money put to work.

The complete agricultural occupation of Canadian lands has not yet arrived, but it is closer to the event than ever before. Agriculturally we shall soon have reached the frontiers of settlement in Canada, but there will still remain vast territories for the exploitation of the prospector and the miner, with future centres of population that will grow up around mining developments that may extend the agricultural limits in a circumscribed way. We are approaching the time when the repercussion of more or less complete agricultural settlement will enlarge the urban districts of the West, and there will then proceed to evolve that increase in industrialism and the intensive development of natural resources which will follow the appearance of the wealthy son of the farmer—himself not a farmer as will naturally happen—and the presence of an urban population from which to obtain the workers in manufacturing industries and mining and quarrying.

In other words, Canada is past the point where she is to be regarded merely as the northern storehouse of raw materials to be used in the industries of the United States. We have lived long enough on our capital in Canada. As Sir John Willison points out there is no ethnical or geographical obstacle between ourselves and our neighbors such as determine nationalities and divert the routes of industry into national channels in Europe.

In their decision to be and to remain a separate nation in North America the citizens of Canada, so Sir John intimates, have undertaken a great political experiment, which can not succeed unless we enlarge the development of those basic industries which will enable us to export a greater value of finished manufactures than we import. Volume of exports, if consisting solely of raw materials, is like to the action of a spendthrift heir which precedes the bankruptcy of the estate.

EMPIRE STEEL'S DONATION TO DALHOUSIE UNIVERSITY.

The friends of education in Nova Scotia will be much heartened by the statement made by Mr. Roy Wolvin, President of the Dominion Steel Corporation, that $250,000 will be given by the companies entering the British Empire Steel Corporation to Dalhousie University, with the idea of "definitely providing for "professorships in research work in connection with "the natural resources of the Province of Nova Scotia.' The justification for this munificent gift is best stated in Mr. Wolvin's own words, namely that any subscription to Dalhousie University at this time "will "be well repaid year after year". Mr. Wolvin said that men who first undertook the founding of a coal and steel industry in Nova Scotia were men of vision, a tribute both accurate and deserved, but to none of the predecessors of those who are now directing the allied industries has there been vouchsafed a clearer vision of the right action at the proper time. The large coal and steel companies in Nova Scotia have themselves been the victims of the meagre facilities for technical research existing in Nova Scotia, and they will be the chief beneficiaries of enlarged facilities.

Mr. Wolvin's statement was made after consultation with Mr. D. H. Mc. Dougall and Mr. J. W. Norcross.

At the Toronto Meeting of the Canadian Mining Institute, Mr. D. H. Mc. Dougall, as the retiring President said: "Efficient and full use of our resources is dependent upon the progress of science, which, applied "to their limitations, and supplementing their deficiencies, will have the effect of increasing their quantity and duration." Mr. Mc. Dougall pleaded for a recognition of the importance of applied science to our young nation, and expressed his belief that it was necessary that the Canadian people should "entirely revise their valuation of the scientific worker."

It is therefore heartening to observe that the most pregnant re-arrangement of industrial forces which has recently taken place in Canada is headed by men who have the desire, as well as the power, to practice what they preach. The gift to Dalhousie University is timely, wise and good business.

THE PROPOSED VANCOUVER ISLAND STEEL PLANT

Mr. H. S. Fleming, President of the Canadian Collieries (D.) Dd., whose inquiry into the opportunity and necessity for a steel plant in British Columbia was referred to in the July issue, recently explained to an audience at Cumberland, B.C. his views on the matter.

Mr. Fleming said there were people prepared to put up a steel plant provided they could find a market for its production. On the coast he had found poeple, when speaking or local steel consumption, had in mind every kind of steel, from pocket knives to blooms. A steel plant itself made just basic things. He was trying to find how much market there would be for pig iron to be used in foundry work, how many billets and plates and stuctural steel could be sold. He considered a steel plant needed at commencement a market of 250 tons daily. The English people he referred to were looking out for the best location, and he was endeavoring to have them locate at Union Bay.

Mr. Fleming said he was surprised to hear it stated that magnetite, of which there was a large quantity in the neighborhood, was unsuitable for furnace work, and did not produce a pig iron from which steel could be made. That was simply ignorance. The Cornwall ore deposite in Lebanon County, Pennsylvania, are magnetites and have been operated for years, producing a high grade of iron, and there are a dozen more magnetite deposits in the United States of which the same might be said. There ore is somewhat harder to reduce in the furnace, but it has been done, is being done, and will be done. There was no lack of limestone.—another important requisite—and no lack of coal, the best on the Pacific Coast.

The speaker thought there was a market for iron products in Washington, Oregon and California. There was no appreciable amount of ore in either Washington or Oregon.

Mr. Fleming said a steel plant must work 34 hours a day, it being a continous process.

A steel plant in British Columbia would attract other industries. For example; 150,000 tons of tinplate were used in the Province, all being shipped from the East.

NEWS OF WELLAND INDUSTRIES.

By Industrial Commissioner Day

The Canada Forge Company, one of the firms in Canada Foundries and Forgings Limited, has completed its steam drop-forge plant and has started production. The new equipment installed consists of 6,000 lb. steam drop-hammers suitable for the production of heavy drop-forgings.

The Canada Forge have contracts in hand to run their new battery of steam drops continuously for six months. This firm has done a lot of re-construction and their layout, which will shortly be completed, will permit of continuous movement from the receiving yard through all phases of operation to the receiving platform. Much expense has been incurred in making all the necessary changes, but the ease with which work will now move through the various operations will be sure to justify it.

The Canadian Mead-Morrison Company, Limited, who acquired M. Beatty and Sons, Limited, some little time ago, have things running very smoothly and are beginning to get results from their extensive sales work.

Just recently the Canadian Mead-Morrison Company have secured a contract to manufacture and install two electrically operated Skip Hoists for handling Sand, Soda Ash and Limestone used in the manufacture of glass at the Ville St. Pierre plant of the Consumers Glass Company, Montreal. All the designing and engineering in connection with this installation is being done by the Canadian Mead-Morrison Company. A special feature is the automatic push button control by means of which the skips may be stopped at any pre-determined point.

They also have a contract to manufacture and install coal handling machines for the new power plant of the Dominion Tire Company at Kitchener, Ontario. This will consist of Mead-Morrison Crusher and McCaslin Grab Bucket Conveyor system.

The Canadian Mead-Morrison Company have acquired from the Waterville Iron Works, Waterville, Maine, the sole right to manufacture and sell in Canada their full line of woodroom machinery for pulp mills. This includes Lombard Chip Crushers, Barkers, Barker attachments, Chippers, Rechippers, Splitters and Shaker Chip Screens.

The Canadian Steel Foundries have about completed their improvements in the steel foundry and have begun production of the Couplers, Bolsters, etc., large order for which they have in hand.

Coke Disposal.

The growth of the by-product coke industry independent of the iron and steel industry and the prospects for developig it primarily, as a source of gas without necessity for relying on the needs of blast furnaces, depend almost entirely on the question of coke disposal. The extension of the domestic coke market is of great importance in this connection, and much progress has recently been made in this direction. The situation bears close relation to the condition of anthracite coal supply which is yearly becoming poorer in quality and more inadequate in amount. Just as the availability of natural gas has accustomed millions of American people to the use of gas fuel for domestic purposes, so the wholesale use of anthracite coal as domestic fuel has paved the way to introduction and substitution of coke.—**Gas Age.**

A NOTABLE GROUP.

Photograph taken at the office of the Dominion Steel Corporation in Sydney during the recent visit of the Directors to the Steel Plant.

Top Row—
H. E. Rice, General Superintendent, Col. Chas. W. Mc Lean, Montreal; H. B. Smith, Director; E. P. Merrill, General Manager; Messrs. Christian and Johnson of the Montreal "Gazette."
Second Row—Roy M. Wolvin, President; Hon. C. P. Beaubien, Director; Sir William D. Reid, Director.
Second Row (seated)—J. Kempton, Secretary to President; J. F. M. Stewart, Director.
Bottom Row (seated)—Stanley E. Elkin, M.P., Director; Hon. J. P. B. Casgrain, Montreal.

Company Notes

Dominion Steel Corporation.

The ship-plate mill is working to capacity, and during July produced about 4,300 tons of plates. Two additional heating furnaces are being installed, which will increase production somewhat.

The Rail-mill has been working on single shift on a 7,500 ton rail order, but is expected to cease rolling shortly, as no rail orders are being obtained.

A fourth blast-furnace is expected to be blown in about the beginning of September. The output of the plant is going away as plates, billets, wire-rods and wire products.

Nova Scotia Steel & Coal Co.

The plants of this Company, both at Sydney Mines and at New Glasgow, are working to full capacity, and sufficient orders are booked to require full work until at least the year end.

The construction of cars at the Eastern Car Co., has been delayed by the difficulty in obtaining deliveries of steel.

Canadian Car & Foundry Co.

Operations at the Lachine works have been hampered by inability to obtain delivery of coal and steel from the United States, and the ships have consequently been working at restricted capacity. The President, Mr. W. W. Butler, states that the Company has some $30,000,000 of unfilled orders, that the shortage of railway equipment in Canada rendered the outlook for the car business distinctly promising. Negotiations for an important volume of export business were also in progress.

MR. R. M. WOLVIN, President of the Dominion Steel Corporation, and MR. H. E. RICE, General Superintendent of the Steel Plant at Sydney.

Canada Foundries & Forgings Ltd., acquire Mann Axe &Tool Co.

The shareholders of Canada Foundries & Forgings at a special general meeting on July 24th ratified the proposal of the Board to acquire the Mann Axle & Tool Co., of St. Stephen, N. B.

The Mann Plant was recently destroyed by fire, but now being carried on with the municipality of St. Stephen if the negotiations succeed the plant will be at once re-built.

Dillon Crucible Alloys Acquired by U. S. Company.

The Atlas Crucible Steel Company of Dunkirk, N. Y., is announced to have acquired a substantial interest in the Dillon Crucible Alloys of Welland, Ont., and the business will now be carried on as the Canadian Atlas Crucible Steel Company. Arthur H. Hunter, President of the American concern will be Chairman of the Board of Directors, and T. J. Dillon, President of the Canadian Company will remain as an officer active in the management of the business.

International Harvester Company adopts Profit-Sharing on Large Scale.

The shareholders of the International Harvester Company have ratified the proposals made by the management to adopt profit-sharing with employees on a scale so far unprecedented in profit-sharing plans in America. The proposal is to set aside $60,000,000 in stock for distribution under the plan, which will be open to the employees of the Company in the United States and Canada, and presumably wherever the activities of this Company extend.

The programme submitted by the directors provides for special disbursements each year beginning January 1, 1921, consisting of stock and cash. It is planned to divide annually an amount equal to 60 per cent of the company's net profits in excess of 7 per cent upon the corporation's invesfed capital.

The full amount of the company's investment is not specifically set forth in the latest statements. At the end of 1919, however, total assets amounted to $188,-869,500, which may be considered an approximate value of working capital, plant investment, inventories, etc. In that year net profits amounted to $21,-011,761. Seven per cent of the aggregate assets would be $13,220,865. Deducting this from the profits and taking 60 per cent of the proceeds, there would be approximately $4,675,000 to be divided among employees on the basis of 1919 income. The company employs about 40,000 workers when operating on a full schedule.

The employees will be divided into two groups, those who are in executive and managerial positions and those who are not. The former will receive one-third of the extra compensation fund and the latter will receive two-thirds, part in the company's 7 per cent preferred stock and part in cash.

Dominion Bridge Co. and Subsidiaries.

No statement has as yet been issued regarding the re-building of the Maritime Bridge Company's plant at New Glassgow, recently destroyed by fire.

The equipping of the Dominion Engineering Works at Rockfield for the extended manufacture of paper-making machinery is being rapidly pushed. It is understood that the prospects for continuous orders for the paper mills are excellent.

Like the other Lachine plants, Dominion Bridge is being restricted by difficulties in obtaining materials from the United States, particularly coal and steel.

At Amherst, the Robb Works are engaged in the construction of farm tractors of the "Tillsoil" type. At the present time the works are manufacturing and shipping an order of 150 tractors.

Montreal

The Joliette Castings & Forgings, Ltd., has been incorporated to manufacture iron, etc., with $1,000,000 capital, by Alexander H. Duff, Walter A. Merrill, Archibald Stalker and others.

The Belanger Foundry Co., has been incorporated to manufacture castings, etc., with $100,000 capital, by Auguste Kean, Elric Genest, Ovide D'Amour and others. The new company will take over the plant and business now carried on by O. Belanger.

Toronto

The Canadian National Railways, 1 Toronto Street, Toronto, has acquired 32 acres at Leaside, Ont., which will be used for extending its repair shops and car-building plant.

The Baldwin Canadian Steel Corporation, has made application at Osgoode Hall, Toronto, for an injunction restraining the town of Collingwood from selling the plant of the Cramp Steel Company in order to recover $64,000 in arrears of taxes, exclusive of five per cent interest allowable on arrears. The Baldwin Company recently purchased the plant. The town, the Judge was informed, did not wish to seize or sell the plant, but merely wished to prevent the industry being moved to Toronto, the town having expended a large amount of money in making extensive improvements for the benefit of the plant. An order was granted preventing the sale and restraining the Baldwin Company from moving the plant until after the trial of an action to determine the rights of the parties.

The Mauson Motors, Ltd., Toronto, has been incorporated with a capital stock of $1,500,000 by Ernest M. Dillon, 49 Regal Road ; Ray T. Birks, room 50, 33 Richmond Street, W., and others to manufacture motor vehicles, engines, etc.

Grinnell & Co., 2440 Dundas Street, West, Toronto, Ont., have awarded contracts in connection with the erection of a foundry building to cost $285,000, and work will be started immediately. It is estimated that the building and equipment for the foundry will cost approximately $500,000.

Ontario

Property and buildings of the Roman Stone Co., Weston, Ont., have been purchased by the Willy-Overland Motor Car Co. The building contains about 40,000 sq. ft. and the site covers 4½ acres. It is said that the premises will be occupied by the Moline Plow Co., which is about to establish a branch plant in Canada.

The ratepayers of Durham, Ont., have granted certain concessions to Clark Metals, Ltd., which in return will establish a plant.

The Orton Motor Co., Ltd., Petrolla, Ont., has been incorporated with a capital stock of $500,000 by Alfred Orton, Detroit, Mich. ; Frank A. Halstead, Port Huron, Mich. ; John Fraser, Petrolia, and others to manufacture motors, engines, machinery, tools, etc.

Beatty Bros., Fergus, Ont., manufacturers of barn equipment, hay forks, carriers, pumps, farm machinery, etc., are making arrangements for the establishing of a manufacturing plant at Regina, Sask., to cost $60,000. The company is also extending its plant at Fergus, Ont., and is installing additional machinery.

Contracts have been awarded in connection with the building of a factory and power house at Windsor, Ont., to cost $250,000, for the Burroughs Adding Machine Co., Piquette Avenue, Detroit, Mich.

MAKE BAR IRON

New Brunswick Rolling Mills Co., Limited, Start Manufacturing Operations at St. John

The New Brunswick Rolling Mills Company, Limited, of which the incorporators are Harry J. Garson, Frank O. Garson and Joseph A. Garson, have acquired the plant and lands of the Portland Rolling Mills Co., Strait Shore, St. John, N.B., and are busily employed in manufacturing bar iron in all sizes, railway spikes, ship spikes, track bolts and mild steel bars. The company, who are capitalized at $99,000, have not yet completed their organization, but Mr. H. J. Garson is provisional president, Joseph A. Garson, secretary and C. H. Lissemore, superintendent.

STATE IRON AND STEEL WORKS IN QUEENSLAND, AUSTRALIA.

In connection with the State Iron and Steel Works which it is the intention of the Queensland Government to install at Bowen, a seaport town on the Eastern Coast of Australia, about 600 miles north of Brisbane, the General Manager Mr. J. W. Brophy, accompanied by the Engineer for Harbours and Rivers, and the Chief Inspector of Mines for Queensland, have left Brisbane on a tour of inspection of iron lodes in Western Australia, the option on which was secured by the Government a short time ago.

These deposits are situated on islands contiguous to Yampi Sound on the north west coast of Australia, are very extensive, and are described by the State Mining Engineer for Western Australia, as "the richest and most accessible of their kind in the World."

The grade of the ore is 69 per cent metallic and it is estimated that there are nearly 100 million tons available above Sea level; while the mining problem present no difficulties as the ore can be quarried by the inexpensive open cut method, and delivered from the bins direct on the ship, the lode running right into the sea, and thereby offering every facility for cheap and efficient handling and shipping.

The Queensland Government is considering the recommendation of Mr. Brophy, that they should purchase for this trade, two steamers of the Lake Superior type, this class of vessels being specially built and equipped for the carrying of iron ores, and possessing great tonnage capacities.

It is the intention to blend those with the Queensland ores of 57 per cent metallic, which it is considered will make excellent iron, and enable the Queensland State Works to successfully compete with any other Iron Works either in Australia or elsewhere.

DOMINION STEEL CORPORATION CREATE OFFICE OF SUPERINTENDENT OF INDUSTRIAL RELATIONS.

The Dominion Steel Corporation have appointed Mr. Angus W. Macdonald as Superintendent of Industrial Relations, having charge of the work of this department as it affects all the operations of the Corporation in Cape Breton, Springhill, Newfoundland and other points.

Mr. A. W. Macdonald has had a unique training for this responsible position. He has been continously in the service of the Dominion companies since the formation of the Coal Company in 1893, having previously worked for the predecessors of the Dominion Coal Company. Since 1900, with an interval during which he was Superintendent of the Black Diamond Coal Company in Lethbridge, Alt., Mr. MacDonald has been the Employment Agent of the Dominion companies, and has been required to visit Europe on several occasions in connection with the recruiting of labor.

The new department will have three divisions, namely, the work of employment, employees service, and safety and first aid work.

The employment division will be charged with the development of sources of labor supply, the selection and placing of workmen, and supervision of the "turnover" of labor, with a view to retaining every employee possible and reducing discharges and notices to quit to a minimum.

The employees' service division will have charge of housing plans, sick benefit and pension schemes and general social welfare of employees. The plans of this division contemplate district nurses, hospitals, garden plots, Company's farm, employees' clubs, athletic, musical and dramatic societies, employees magazine, boarding camps, cafeterias, restaurants and the accomodation for single-men boarders.

A. W. MACDONALD,
Supt. of Industrial Relations, Dominion Steel Corporation.

The safety first division will endeavor to organize safety committees and first-aid work, the compilation of accident statistics, communal sanitation and cleanliness, water supplies, and educational bulletin service.

The assistants which the new Superintendent of Industrial Relations has been assigned are all men of competence and long experience.

There is a widespread and pressing necessity for just such activities as are contemplated in the programme of organization of the Steel Corporation's new department. Many sporadic attempts at improvement of living conditions and the environment of the colliery towns and steel districts have been made, but they have never been co-ordinated, and their continuity has been affected by changes in control and management, periods of trade depression, and, to a large extent, by non-realization of the necessity for a department of corporate industrial activity that is not, as is sometimes supposed, philanthropy or paternalism, but just ordinary common sense and good business.

It is not to be expected that all the various activities contemplated will at once assume full shape, as the new Superintendent will have to overcome a good deal of inertia and incredulity, and he may not inconceivably meet actual opposition, but in appointing Mr. Macdonald to a position that will be in its initial stages an experimental one, the Corporation have acted very wisely, as Mr. Macdonald possesses just those qualifications of patient persistence and ability to impress his views upon others, combined with a uniquely complete knowledge of the labor situation in the Corporation's works and mines, that will make success probable, given sincere backing by the operating heads.

The paper on "Labor Turnover of Industrial Plants" read by Mr. Macdonald before the Mining Society of Nova Scotia, which appeared in our issue for May, was a convincing presentation of the loss that occurs through unnecessary changes in working personnel, and a strong plea for its minimization.

BRITISH EMPIRE STEEL CORPORATION LIMITED

Ratification of terms of entrance in this consolidation, as recommended by the Boards of Directors and proposed by the promoters, has been signified by shareholders' meetings of the Dominion Steel Corporation, Nova Scotia Steel & Coal Co., Canada Steamships Lines, and the several subsidiaries of these companies, so that the consolidation is virtually accomplished.

British Empire Steel issues "if, as, and when issued" are being quoted on the New York Curb, the price ranging round 20 for common stock and 48 for the seven percent preferred stock.

Col. Grant Morden has returned to England, but is expected to return in the early Autumn, when announcement is expected of the officers of the Corporation and of stock offerings.

SHIPBUILDING

Victoria, Vancouver Island.

Mr. Bayly Hipkins has resigned the position of Vice-President of the Foundation Company and management operations on the Pacific Coast, which, in addition to shipbuilding operations in Portland and Tacoma has included shipbuilding contracts at Victoria, B.C., said to total $13,000,000.

Six ships of the Admiral Line are to make Victoria a port of call. Four of the vessels will be operated from Seattle and Victoria to Japan, China and Manila, and two will be operated from Seattle and Victoria to Vladivostock and T'singtau. Vessels of 12,600 tons d.w., 17 knots, with oil-burners and accommodation for 550 first and third-class passengers are included in the Admiral fleet, being new vessels just completed and allotted by the U.S. Shipping Board to Pacific Coast service.

Collingwood, Ont.

The oil-burning steamship "Transpet," built by the Collingwood Shipbuilding Company for the Standard Oil Company was launched on the 27th July This is the sixth vessels of similar type built at the Collingwood yards. The "Transpet" is 170 ft. long, with 35 ft. beam, and a carrying capacity of 520 tons of oil. She will go to Buenos Aires, calling for fuel at Montreal and at Halifax en route.

Vancouver, B.C.

J. Coughlan & Son will lay the keel of a fifth steamer built to the company's own order. The vessel will be of the same type as the preceding four, namely 8,800 tons dw. Three vessels of these dimensions have already completed so far this year, and the fourth is about half finished.

Work has not yet commenced on the Government steamers on order, the plates which are coming from the Sydney mill, not having been received.

Montreal.

The "Canadian Conqueror" was the latest vessel launched by Canadian Vickers, the ceremony being performed by Mrs. Gilham, the wife of the Managing Director of the Company. This vessel is the ninth built at the Longue Pointe yards for the order of the Canadian Government. Dimensions are 413 ft. long by 52 ft. beam and 31 ft. deep. The vessel is fitted with refrigerating machinery, and her accessories are of the best, all cargo handling gear and winches, steering-gear, etc., being made by Messrs. Vickers at Maisonneuve.

Three further vessels are on order at this yard from the Government, the keel-plate for one being already laid. Construction has been held back by the difficulty in obtaining delivery of steel.

Toronto.

The Dominion Shipbuilding Company of Toronto has made an assignment for the benefit of its creditors under the Bankruptcy Act. Eight hundred employees are affected by the closing down of the yard, and their wages will be a first lien on the assets. It is stated by the Company's counsel that when an accounting is made the assets will exceed the liabilities. The success of the company has been militated against by strikes of workmen, causing delays in delivery of vessels, which have rendered penalty clauses operative. The resumption of work at this plant depends on the attitude of the principal shareholders, who belong mostly to New York. It is stated that no shareholder or director has ever received any dividend or remuneration, and that all the money earned has been disbursed in wages.

New Glasgow.

The Nova Scotia Steel & Coal Company has launched the "Volundia" of 2,800 tons dw. capacity. A second ship of like size is nearing completion, and a third keel is being laid. The "Volundia" is the seventh steel ship built at this yard.

The contract for the construction of the Burrard Inlet government drydock has been let to J. Coughlan & Sons, and under the provisions work is to be started within sixty days. The estimated cost of this dock is $3,000,000, and it forms a part of extensive works for the improvement of Vancouver Harbor as a shipping port.

Sydney Ship Plates for New Zealand.

The S.S. "Otira" is taking 1,000 tons of ship plates from Sydney, N.S., to New Zealand. This mill has already rolled plates for Melbourne, Australia, and for shipment to Great Britain.

CANADA STEAMSHIPS LINES HAVING GOOD RETURNS

The President of Canada Steamships states that the passenger business offering this season is greater than can be taken care of, while freight earnings are in excess of last year's. Operating expenses, particularly increased fuel costs and wages, are in excess of those of last year, but the net earnings are expected to compare favorably with the record earnings of 1919.

The Future of the Lake Superior District as an Iron-Ore Producer Depends on Successful Beneficiation of Low Grade Ores

By EDWARD W. DAVIS (in "The Iron Trade Review.")

In the past, a very large proportion of the iron ore used in the United States and in the world has been secured from the Lake Superior iron mining district. Production has been at an enormous rate, and the question naturally arises as to how much longer this district can continue to supply the demand. A study of the situation brings out the encouraging fact that the district can continue to produce immense tonnages of iron ore for many centuries by utilizing its low-grade ore material. In a broad sense, low-grade ores may be said to include all material containing too small an amount of iron and too large amounts of nonferrous minerals to be considered merchantable as mined. In addition to this, low-grade ore may also include material of acceptable iron content, but of such physical structure that it can not be used in the blast furnace. For the purpose of discussion, low-grade iron ore may be considered as iron-bearing material that does not meet the present demands of the blast furnace operators and cannot, therefore, be sold as mined.

This general classification contains all nonmerchantable ores and may be divided into several subdivisions. On the basis of iron content, they may be classified as follows:

1. Ores containing less than 40 per cent natural iron.
2. Ores containing between 40 and 50 per cent natural iron that are used to some extent at the present time as concentrating ores, or are mixed with ores of high iron content in order to increase the tonnage.
3. Ores containing over 50 per cent natural iron that are not in proper physical condition for blast furnace use.

In the first classification will be found the largest portion of low-grade ore material in the Lake Superior district. A much smaller amount of material will be found in the second classification and, comparatively, a very small amount of ore may be classified under the third division.

The total amount of low-grade ore in the Lake Superior district is enormous. It has been variously estimated by ambitious geologists at from 30,000,000,000 tons to "enough to last the world 1000 years." No matter upon what basis the question is considered, it is evident that there is a sufficient amount of low-grade ore in the district to warrant a detailed study as to methods of utilization, and if methods of treatment can be developed by which this material may be utilized, a sufficient amount of ore is available to supply the demand for many generations.

Look for New Sources of Supply.

Unfortunately, so little interest has been manifested in connection with this low-grade material, that much of the information regarding tonnage and quality that might now be available, has been lost. Thousands of feet of drill core have been thrown away, leaving no record other than the drillers' notation, "taconite". If all of these cores had been saved, tests could be made on them which would furnish priceless information for future guidance. The practice of destroying drill cores, especially if they show any evidence of the iron formation, should be discontinued.

It is, of course, recognized by everyone, that at some future date all of the merchantable ore will have been removed from the district. This date is placed by various estimators at from 15 to 30 years hence. This statement is based on the assumption that the present rate of shipment will continue until the end of the season of the last year. This, of course, can not be the case. The history of any successful mining district shows that during the first few years of life small tonnages of high-grade material are mined. As time passes and a district is more largely exploited, the tonnage mined each year increases. As the tonnage increases, the grade of the ore usually becomes lower. After a certain time, the yearly production of the district reaches a maximum and after the maximum is passed, the production gradually decreases. The rate of decrease in production is quite rapid at first, but absolute depletion of the district may not occur for a great many years. The history of the Lake Superior district will, undoubtedly, follow in a general way the history of most mining districts and it is to be expected that some day, past or future, the district has reached, or will reach, the peak of its production. After the peak is passed, and it becomes generally recognized that the district is on a decline the descent toward absolute depletion will be quite rapid.

The distribution of the Lake Superior ores among the various furnace companies shows that, while some companies have a sufficient supply of ore to last them 30 or 40 years, other companies have enough to last only five or six years. These companies are already looking about for new sources of ore supply, and if they are not to be found in the Lake Superior district the companies will go elsewhere. Serious attempts are already being made to bring the Cuban and South American ores into competition with the Lake Superior ores, and undoubtedly the furnace companies that are expecting a shortage of ores will be only too glad to aid in the exploitation of new mining districts. When serious competition once starts against the Lake Superior district, production will decline rapidly. When this decline is generally recognized, it will not be as easy a matter to get new railroad equipment, new lake carriers, or new ore docks, as it has been in the past and investors realizing that the life of the district is limited to a few years, will hesitate to contribute more capital. This in turn will tend to reduce production further and to hasten the extinction of the district. It is a well-known fact that a mining district, once started on the down grade, gains impetus rapidly.

Abstract of Bulletin No. 7 of the University of Minnesota's School of Mines experimental station, entitled "The Future of the Lake Superior District as an Iron Ore Producer."

Summing up the whole situation, it appears that very serious competition might exist at the present time, if it were not for the fact that the Lake Superior district is in actual operation on an immense and efficient scale as compared with competing districts. In other words, the strength of the position in which the Lake Superior district finds itself lies in the fact that it is now actually producing sufficient ore to supply the demand. Quoting from a recent publication by the Minnesota school of mines experiment station: "The wonderful transportation systems, ore handling and dockage equipment, organizations and capital of the Lake Superior district are now available and ready to assist in prolonging the life of the iron-ore industry. In this respect, the Lake Superior district has great advantage over many other mining regions, but capital is very mobile and railroads and docks can be allowed to deteriorate and as the future ore supply becomes more and more uncertain, this great advantage may gradually disappear."

Returning to the original question as to whether or not it will be necessary to utilize the low-grade ores of the Lake Superior district, it appears that it will not only be necessary to utilize these ores in order to maintain the production of the district, but it will be necessary to begin the utilization of them in the very near future. If the furnace companies that have only a few years' supply of ore available are allowed to invest large amounts of capital in developing and bringing into production new mining districts, the Lake Superior region will immediately start on its decline. If, on the other hand, these furnace companies find that the low-grade ores can be utilized, the fact that the Lake Superior district is already in large production and is so well equipped to handle immense tonnages will cause them to contemplate seriously investing new capital in this district for the purpose of developing the low-grade iron ores. The development of such an industry on a large scale will extend the life of the district into the far distant future.

Having arrived at the conclusions that the Lake Superior region has an almost inexhaustible supply of low-grade iron ore that the utilization of this material is essential in order to maintain the production of the district, and that now is the time to start his low-grade iron-ore industry, the next logical question is, by what means may these low-grade ores be made useful.

Making Low-Grade Ores Merchantable.

There are, in general, two factors that may make the utilization of the low-grade iron ores possible. These may be summed up as follows: First, a relative increase in the selling price of iron and steel, which will cause a readjustment in the schedule of iron-ore prices as determined by the Ore Buyers' Association and second, a decrease in the present cost of producing iron and steel from these low-grade ores.

The possibilities offered by the first consideration seem to be slight. Any relative increase in iron and steel prices may come about only from an increase in demand that can not be met by smelting only the so-called merchantable ores of the present time. Such a condition would make possible the utilization of a certain proportion of low-grade material. It must be remembered, however, that these conditions would bring several other iron-mining districts into strong competition with the Lake Superior region, and this district would receive only a portion of the benefit of the increase in price. For this reason, the holding of all the low-grade ore material as reserves of future shipping ore would eventually bring this material into such strong competition with ore from other districts that the Lake Superior low-grade deposits would probably never be utilized to any great extent. It seeems, therefore, that the utilization of the Lake Superior low-grade ores through an increased demand caused by depletion of high-grade ores, thereby producing a readjustment in the iron-ore prices, should not be counted upon to make possible the utilization of the vast amount of low-grade material in this district.

The second possibility, namely, a decrease in the present cost of producing iron and steel from this low-grade ore material, should receive very serious consideration. In order to discuss this question intelligently, it is advisable to inquire into the present cost of producing iron in a blast furnace from low-grade ores.

In a report recently make by J. R. Finlay to the director of the United States bureau of mines, considerable information is given which bears directly upon this subject. In considering the figures that appear in the report, deductions can be made, showing that for every increase of one unit of silica in the ore, the cost of producing a ton of pig iron, exclusive of the cost of the ore, increases about 20 cents. Therefore, if two tons of ore are required to make one ton of pig iron the addition of one unit of silica to the ore increases the cost of smelting by about 10 cents per ton. The freight on this additional one unit of silica is about 2 cents, and therefore the addition of one unit of silica to iron ore before shipment decreases its real worth by about 12 cents per ton. In a similar manner, it may be shown that the addition of 1 per cent moisture decreases the real worth of the ore by 2 cents per ton.

Certain modifications of these figures would be necessary in order to make them represent present conditions. Whether or not the figures are exact, they give a fair basis on which to judge of the economic importance of removing the silica from low-grade ores before shipment. In order to produce a maximum increase in the real value of the ore, the silica should be removed before shipment, up to a point where its removal costs 12 cents per unit. Above this point, the silica can be removed more cheaply in the blast furnace. If the silica content of an ore can be reduced before shipment from 18 per cent to 8 per cent by mechanical means, one ton of the ore can be shipped and made into pig iron at a saving of $1.20. If these 10 units of silica can be removed from the ore mechanically at a total cost that is less than $1.20 per ton, the ore should be treated and the silica removed before shipment.

Four Processes Available.

It is then evident that before these low-grade ores should be smelted in a blast furnace, a large amount of the silica and moisture which they contain should be removed mechanically. This, and this only, will make possible the production of iron and steel at a price that will allow these ores to compete with the present grade of merchantable ores. Any reduction in freight rates or handling costs or any improvement in iron and steel metallurgy will have the effect of raising the allowed limit of silica and moisture that shipping ores may contain, but it is difficult to

ceneeive of any immediate improvement in smelting methods that will make possible a removal of a very large amount of silica from the ores by metallurgical means more cheaply than by mechanical means.

A study of the methods that can cope with the problem of handling thousands of tons of hard iron ore daily at an extremely small operating and maintenance cost narrows the field, at the present time, to four processes. These may be classified under the heads of log-washing, table concentration, jigging and magnetic concentration. Log-washing and table concentration, as originated in this district by the Oliver Iron Mining Co. are now in general use. Jigs are in use to a small extent, and the first plant in which magnetic concentration is to be attempted is now being built. Each of these four methods of treatment operate in connection with ores having certain definite characteristics which make them amenable to one or more of the concentration methods.

The last method of treatment to make its appearance in the Lake Superior district is magnetic concentration. This method of beneficiating iron ores has been in use for many years in New York state and Canada and some foreign countries, but, until recently, it has not been used in this district. A brief consideration of the working principles upon which this process is based may be instructive.

One strange characteristic of magnetism is that it may be made to exist to any considerable extent in only a comparatively few materials. These are called ferromagnetic materials and in this class may be placed the metals iron and nickel, and the minerals magnetite and franklynite. The iron oxide, magnetite, comes within this group and it is, therefore, a comparatively simple matter to remove the magnetite from an ore after it has been crushed sufficiently fine to free the particles of magnetite from the gangue.

Magnetic Method for Hematite.

Unfortunately, however, a large proportion of the low-grade ore found in the Lake Superior district is not magnetite but hematite, which is an oxide of iron that is not ferromagnetic. Hematite, therefore, can not be easily concentrated magnetically. It is, however possible to change hematite into magnetite by a very simple operation known as magnetic roasting. This process consists in heating the hematite to such a temperature and under such atmospheric conditions as will cause a small amount of the oxygen to be driven off. Pure magnetic oxide contains 72.4 per cent iron and 27.6 per cent oxygen, and pure hematite, the non-magnetic oxide, contains 70 per cent iron and 30 per cent oxygen. It is, therefore necessary to remove 11 per cent of the oxygen present in the hematite in order to change it into magnetic oxide. This would decrease the weight of the hematite by only 3.3 per cent. The process of magnetic roasting consists in heating the hematite ore to a temperature of from 400 to 600 degrees Cent., in the presence of a small amount of fuel such as fuel oil, soft coal, lignite, or possibly peat. The fuel produces reducing gases which remove the necessary amount of oxygen from the hematite and change it to the magnetic oxide. The process can be carried on in rotary kilns; and on a large scale in properly equipped plants magnetic roasting can be accomplished rapidly and at a small cost. This roasting method of producing magnetic material from hematite is not at present in use to any great extent.

In considering magnetic concentration, as applied to the Lake Superior low-grade ores, there is a possibility of using this method of treatment in producing a merchantable product from the low-grade hematites as well as from the magnetites. Since magnetic concentration can be carried on successfully with ore as coarse as 5-inch cubes and as small as the finest dust, it at once becomes apparent that this method of beneficiation is of great future importance and deserves considerable study.

Just as gravity concentrators are divided into several classes, depending upon the nature of the work, so magnetic concentrators take several different forms, in order to produce different results. Magnetic concentration has a great advantage over gravity concentration. This is due to the fact that the magnetic attraction can be easily varied between wide limits, while the attraction of gravitation always remains unchanged. This introduces a controllable variable into the process of magnetic concentration which is not found in gravity concentration, and which opens up many new possibilities.

When magnetism is applied to the separation of coarse material, the concentration process is usually carried on with the ore in a comparatively dry condition, and when applied to fine material carried on with the ore in a wet condition. The type of machine that is known as the drum cobber is generally used in the dry process. This machine is, in reality, a short belt conveyor, 6 or 8 feet in length, the head pulley of which is equipped on the inside with magnets. These magnets revolve with the pulley in one type of machine, and in the other type the magnets are held in a stationary position, allowing the surface of the pully and the conveyor belt to revolve about them. The revolving magnet type of cobber is used to make separation of material from 5-inch to 2-inch cubes. The stationary magnet type of cobber is used in making separations on material from 2-inch to 28-mesh. Neither of the types of machines operate satisfactorily on ores containing any considerable amount of material which will pass a 281-mesh screen.

In operating the magnetic cobber the ore is evenly distributed over the surface of the conveyor belt near the tail pulley. It is than carried by the belt to the magnetic head pulley, where the nonmagnetic particles fall into one compartment beneath the machine, while the magnetic particles cling to the belt and are carried around to the under side of the drum and there fall into a separate compartment. The capacity of this type of machine is large, varying from 10 to 30 tons per hour, depending upon the size of the particles and the nature of the separation desired. The belt is is ordinarily 30 inches wide and travels at a speed of 200 feet per minute. The operating cost, as well as the first cost of this machine is very small and it is admirably adapted to the treatment of large quantities of hard rocky material. By adjusting the strength of the magnets, material of nearly any desired iron content may be separated from the rest of the ore.

While material finer than 28-mesh can not be satisfactorily treated on the drum cobber, there are several types of machines, however, that make a very efficient separation of magnetite ores which are crushed to 28-mesh or finer . The finer the ore is crushed, the better is the separation that can be made by the use of these machines. Several of these concentrators for finely pulverized ores take the form of magnetic drums more or less completely submerged

in water. Probably the machine of this class best known in the Lake Superior district is the one which has been called the magnetic log-washer. This machine, designed, built, and tested in the laboratories of the Minnesota school of mines experimental station, is similar to an ordinary log-washer in construction with the exception that to the bottom of the tank of the washer is attached a series of magnets. These magnets tend to hold the magnetic material to the bottom of the trough where the action of the logs forces the settled ore up the slope and delivers it as a clean concentrate, while the nonmagnetic material is kept in agitation and is washed over the rear end of the machine as tailing. This machine is very simple and cheap to operate, and the wear on the logs is much less than in ordinary log-washers, due to the fineness of the particles of ore which are treated.

Agglomerated Product Valuable.

There is available, then, simple, satisfactory apparatus of large capacity suitable for the concentration of magnetic ores. If a separation can be effected at some coarse size, no further treatment of the concentrate is necessary. If, however, it is necessary to crush the ore to some size finer than 28-mesh, the concentrate is usually produced wet and must be dewatered and agglomerated before it becomes desirable furnace product. The dewatering can be effected simply and rapidly by means of the continuous rotary filters. The product of these filters contains the amount of moisture necessary for agglomerating treatment which may be carried out by sintering nodulizing, or briquetting. These processes of agglomerating are already in use by many of the furnace companies, in connection with the utilization of the flue dust which is made in the blast furnace. This agglomerated product is rapidly becoming recognized by the furnace operators as being far superior in structure to the majority of raw ore.

The Eastern Mesabi Venture.

The whole process of magnetic concentration as applied to the eastern Mesabi magnetites is a good illustration of the manner in which the various types of machines can be made to work together so as to produce a high-grade furnace product from an ore material containing only 25 per cent of iron in the form of magnetite. The hard rock is first crushed to about 3-inch size and is then passed over a magnetic cobber. The field strength of this cobber is so adjusted that all of the coarse material containing no magnetic iron is discarded as tailing. The concentrate from this cobber is still too low grade to be useful, and is, therefore, crushed again to 2-inch size. This material is passed over a second cobber and the worthless gangue again discarded. This process of crushing, cobbing, and discarding worthless material continues until the product has been reduced to about ¼-inch size. When this stage has been reached, approximately one-half the ore has been discarded as tailing and the other half contains practically all of the magnetic oxide that was originally present in the rock. This ¼-inch material, however, still contains too much gangue to be considered a desirable furnace product. It is, therefore, crushed wet in ball mills until it will all pass a 100-mesh screen. This fine material is concentrated by magnetic log-washers in which the final separation is made. The concentrate produced by these machines is then dewatered by the use of continuous filters in the tank of which the fuel for sintering is mixed. The filter cake is conveyed directly to the sintering plant where the ore is agglomerated. After being sintered the ore is screened in order to remove any fine material, and only the clean coarse sinter is shipped to the furnaces. It is apparent that in order to make this process a success financially, a large initial investment is necessary. The plant must be built in the most substantial manner, and only that machinery can be used which will operate efficiently and continuously under heavy loads and with little personal attention. At best, the profit per ton that can be made is small, and in order to make the proposition attractive financially, a plant of large capacity is necessary. While this process is a success, from the metallurgical point of view, its financial worth must yet be demonstrated. The Mesabi Iron Co. is now undertaking the last stage in the experiment, that is, the proving of the financial worth of the process.

As has been pointed out, now is the proper time to get this new industry under way. A great deal depends upon the success of this undertaking; possibly the whole future development of the district depends upon the success or failure of this particular attempt. If this undertaking proves successful, furnace companies looking for future ore supplies will be encouraged to secure them from the immense tonnages of low-grade Lake Superior ores. In this case, the district is just now starting on a new era in its history, and great activities may be expected in the future in the low-grade iron-ore industry. On the other hand, if this undertaking by the Mesabi Iron Co. proves to be unsuccessful, a great many years may pass before another serious attempt will be made to utilize the low-grade ores. In fact, if the previous conclusions in this discussion are correct, the failure of this first endeavor will probably cause the people in search of future ore supplies to look elsewhere, and the immense amount of low-grade ore available in this district may never be utilized.

It now is apparent that the success or failure of this first attempt means much in the history of the Lake Superior region. Thoughtful men of the iron-mining industry are watching the progress which D. C. Jackling and his associates in the Mesabi Iron Co. are making with the greatest interest. They recognize the fact that failure means a gradual decline of the district, while success means the awakening of a new period of activity. If the hard rock of the eastern Mesabi containing only 20 to 30 per cent iron can be mined, crushed, and concentrated into merchantable ore, it is not difficult to believe that the vast amount of comparatively soft hematite containing from 35 to 45 per cent iron can first be rendered magnetic by roasting and then concentrated magnetically in the same manner as previously described for eastern Mesabi rock. It will be necessary for some group of men, having ample financial resources, to undertake the work of proving the possibilities of this method of treatment, exactly as the Mesabi Iron Co. is doing with the magnetic ores.

It should be clearly understood, however, that the profit per ton that can be made by treating low-grade material will be very small, and only by handling immense tonnages will real success be assured. The state must realize this fact in connection with its taxation problems, and the property owners must understand that this ore material is worth nothing until it is manufactured into a merchantable product. They must, therefore, be content with small royalties.

In considering the situation as a whole, it seems that the people of the Lake Superior mining district are certainly to be congratulated upon their past accomplishments and upon the bright outlook for the future. The low-grade iron-ore industry is beginning, just as it should, long before the merchantable ores have been exhausted. The state of Minnesota need have no fear of an iron-ore shortage or a barren waste of abandoned mining lands. The iron-ore industry will be thriving and in this district as long as iron and steel are useful metals, provided careful and exhaustive study of the treatment of low-grade material continues and all possible encouragement is given to this important industry by state and federal authorities.

IRON ORE.

By J. J. O'Connor.

A notable forward step in the direction of utilizing Canada's vast deposits of low grade iron ores, has been made in the results obtained by Prof. Alfred Stansfield of McGill University.

The announcement, just made, by The Honorary Advisory Council for Scientific and Industrial Research, Ottawa, that the task allotted to Prof. Stansfield of determining the best method to pursue in bringing these ores to merchantable grades, has resulted so satisfactorily, and at such small cost, that if they had available funds at their disposal, they would undertake a demonstration on a commercial scale.

James W. Moffat, M.E.I.C., Toronto, has been experimenting along the same lines for some years, and is said to have perfected an extremely simple and successful process, that offers great possibilities in the future of low-grade iron ores. Mr. Moffat has taken out patents in Canada, and various other countries, on both the processes and apparatus.

The announcement of the Advisory Council, coming as it does, from the highest scientific body in Canada, should be sufficient warrant for the Government to furnish the money necessary to carry out this most important investigation. In lieu of this, they should make the whole question of the utilization of our low-grade iron ores the subject of departmental investigation. They have the necessary machinery in the Mines Branch, if the matter be not left to the Advisory Council to carry out.

This question has been urged upon the government by representatives of the mineral and industrial interests, by deputations of Members of Parliament, representing all classes. All has been said, that very well can be said, in urging some form of government assistance in developing an iron industry in Canada. It is now time for action. The results obtained by Prof. Stansfield clears the decks for that action, and it should no longer be deferred.

The Government that had the courage to stop borrowing, impose luxury taxes, and pay its debts out of its own resources, so as to make Canada and Canadians self reliant, should have the courage to take one more step, and make Canada independent in the matter of iron ore.

Operations are now being carried out on the eastern Mesabi range, in Minnesota, by the Mesabi Iron Company, on ores similar to much of our own, where millions are being expended in erecting a plant, and constructing the town of Babbitt. The first unit of this plant will cost three million dollars, and have a capacity of 3000 to 4000 tons of magnetic ore daily. All of this is being done after the most careful investigation, and the expenditure of over half a million dollars in a testing plant at Duluth, under the supervision of experienced engineers. This operation, of itself, should be sufficient stimulus to the Government to, at least, make the question a subject of investigation.

In Minnesota, where the greatest known deposits of high-grade ores in the world, are being exploited, the iron operators are taking steps to meet the conditions that are bound to arise as their high-grade ores near exhaustion. Every season sees an increased amount of beneficiated ores shipped from the Minnesota ranges, until now it runs into millions of tons annually.

Skillings "Mining Review," an authority on Minnesota iron ores, has this to say regarding the low-grade ores: "Non-merchantable iron ore of the Mesabi range is the greatest potential tonnage asset of the State. The fact is that the known deposits of merchantable ore compose but a fraction of the tonnage that will be shipped from the range, unless some short-sghted-policy, such as a tonnage tax, makes its appearance to discourage capital and inventive genius from converting non-merchantable ores into merchantable ores."

There is no question in the minds of Minnesota operators, but that their lean ores can be profitably converted into commercial grades, if they are not taxed out of the market by faulty legislation. What is true of the Minnesota ores of low iron-content, is equally true of Ontario ores of similar character.

Therefore, in the light of Prof. Stansfield's determinations, the Government should take this matter in hand without unnecessary delay, should pursue it to a definite conclusion, and settle the question of its commercial feasibility.

MINERALS OF HASTINGS COUNTY, ONTARIO.

On the occasion of the visit of the American Institute of Chemical Engineers to Belleville, Mr. J. W. Evans, who is the Vice-Chairman of the Hastings Branch of the Canadian Institute of Mining and Metallurgy, and who it will be remembered gave a paper at the last annual meeting of the Institute descriptive of the mineral occurrences of Hastings Co., had on view a number of mineral specimens. The most striking was a large piece of iron pyrite from Queensboro, said to be representative of a vein running five feet wide. A specimen of green fluorspar from the Bailey Mine, and a smaler piece of transparent white spar were shown. Samples of the talc from the Henderson Mine at Madoc were exhibited showing the material in various stages of density. Gold ore from the Belmont Mine, and specimens of molybdenum and galena were also shown. A fine sample of iron ore together with tool-steel made direct from this ore in the electric furnace was the occasion of much interestd comment. This ore is stated to contain 53 percent of iron, 7.5 percent of titanium and .41 percent of vanadium.

Mr. Evans is an enthusiastic believer in the mining and metallurgical possibilities of Hastings Co., and is doing good work in bringing them to public attention.

Iron Portland Cement, With a Classification of Cements Made From Blast-Furnace Slag

By EDWIN H. LEWIS (Wishaw.)

Three papers dealing with the manufacture of cement from blast-furnace slag have been read before the Institute by C. de Schwarz. In the first, in 1900, he described a method of making Portland cement in shaft kilns. The second, in 1903, gave details of various cements, and among others of Portland cement mant made in rotary kilns, and iron Portland cement. The third paper, read in 1908, referred to various uses of blast-furnace slag including the manufacture of cement.

Many different cements can be made from blast-furnace slags, the quality of which can vary as much as the methods of manufacture. There is at present a great demand for cement, and a number of iron-masters are thinking of using their slag for its production. In some cases they have it in their power to produce an article equal or superior to London Portland cement. Much of the cement made from slag in the past fell far below this standard, and consequently there is a great prejudice among engineers and architects against "slag cement." In this general term they include every kind of cement made from slag, without troubling themselves to inquire into the quality of any given brand or its method of manufacture. Just as they include all varieties under the heading "slag cement," so they exclude them all from their specifications, because some makes contain too much sulphur or too little of something else to suit them.

Perhaps it would be well to attempt a rough classification of all cements made from blast-furnace slag. They can be divided into the following five classes:

1.—Blast-Furnace Slag as a Cement.

Blast-furnace slag consists mainly of the same constituents as Portland cement—lime, silica, and alumina—but in different proportions, and instead of the raw materials being heated only to the point where the eutectic melts, they are completely fused. If a slag be reasonably high in lime, properly granulated, and afterwards finely ground, it has the properties of cement, although its setting time is slow. The following table shows the tensile tests obtained from briquettes made from such a slag. This was run from the furnaces at Wishaw where haematite iron was being made.

Table I.—Tensile Tests of Briquettes made with Ground Granulated Blast-Furnace Slag, September 29, 1915. (Stored in Air.)

	Tensile Strength in Lbs. per Sq. In.
Broken after 3 days	195
" 7 "	300
" 28 "	430
" 2 months	480
" 4 "	480
" 6 "	615
" 12 "	470
" 18 "	528
" 2 years	666
" 3 "	765
" 4 "	807

*A paper presented at the Annual Meeting, May, 1920, of the Iron & Steel Institute.

The slag contained:

	Per Cent.
Lime	49.4
Silica	30.5
Iron oxide and alumina	16.6
Magnesia	2.3
Sulphur	2.41

2.—Slag Cements.

Under this head could be included those cements which are or have been made from raw granulated slag and lime, finely ground together, with or without the addition of small quantities of other salts. Numerous papers have been published giving descriptions of such cements. Generally speaking, they are quite useful, and the cost of manufacture is relatively low. But they cannot, and should not, be compared with Portland cement. As the slag is not reburned, the sulphur contents are usually high. The high-limed slags, which have the most cement-like properties, generally contain most sulphur. It is such cements that have created amongst engineers the great prejudice against any cement in which slag has been used as a raw material.

3.—Portland Cement.

The British Standard specification for Portland cement defines it as "manufactured by intimately mixing together calcareous and argillaceous materials, burning them at a clinkering temperature and grinding the resulting clinker, so as to produce a cement capable of complying with this specification."

"No addition of any material shall be made after burning other than calcium sulphate or water, or both, and then only if desired by the vendor and not prohibited in writing by the purchaser."

This definition can be satisfied by using slag and limestone in exactly the same way as the chalk and mud of the Thames and Medway are used, or any materials whatever which give the same proportions of lime, silica, and alumina.

The manufacture of such cement is carried on by the Universal Portland Cement Company in America from blast-furnace slag, and the process was described by W. M. Kinney.†

4.—Improved Slag Cement.

Some makers, finding that the slow and uncertain setting of the cement made from ground slag and lime was a serious disadvantage, have made a rather better article by adding to granulated slag a proportion of Portland clinker burnt from a mixture of slag and limestone. Such an addition improves the setting time and strength of the cement and reduces the quantity of sulphur, without adding very seriously to the cost.

5.—Iron Portland Cement.

If a certain quantity of properly granulated slag of the right chemical composition be added to Portland

† Proceedings of the Engineers' Society of Western Pennsylvania, vol. xxv. pp. 103-138.

clinker, during grinding, the strength of the cement can be increased. The quantity of slag which gives the greatest increase of strength will naturally vary with the composition of the slag and clinker. Such a cement might even be called an improved Portland cement. The amount of the improvement possible to some well-known cements, both for neat cement and sand tests was shown by Mr. E. Deny and the present author in a paper read before the Faraday Society on January 14, 1918, and the subsequent discussion. In Germany the iron Portland cement makers and the Portland cement makers have agreed that such cements shall be sold under the name of iron Portland cement, provided that the quantity of slag added to clinker shall not exceed 30 per cent of the whole. It is by making iron Portland instead of the inferior slag cements that ironmasters can break down the prejudice existing today against all cements made from slag; for they will then be making an article which may excel in quality the best Portland cement.

Manufacture of Iron Portland Cement.

There is no need here to desribe the manufacture of iron Portland cement. Except for the addition of granulated slag to the clinker as it goes to the finishing mills, it follows the dry process of making Portland cement. This is well known, and is described in many text-books. There would be grave difficulty in using the wet method, because those slags which are most suitable for iron Portland cement would tend to set in contact with the water in the mills.

As slags vary in different works, each firm would have its own peculiar problems to solve to obtain the great strength from its materials. Slags in any one works also vary from hour to hour, and close chemical supervision is necessary both in the burdening of the furnaces and in the cement works to ensure a uniform product. The variation need not be very wide, and should be corrected by mixing at every point of the process.

Iron Portland Cement and the British Standard Specification for Portland Cement.

The latter half of the clause already quoted from the Standard specification at once excludes iron Portland cement, but it is interesting to see how far such cement can comply with the tests.

(*a*) *Fineness.* (Residue on 180 x 180 sieve not to exceed 14 per cent; residue on 76 x 76 sieve not to exceed 1 per cent.) This is merely a question of adequate mill capacity.

(*b*) *Specific Gravity* (not to be less than 3.10). This is designed to detect addition which would be excluded by the first paragraph of the specification. Iron Portland must be excluded under that clause, therefore the specific gravity test is not of much consequence. Some good Portland cements do not comply with it. The specific gravity of the Portland clinker made at Wishaw runs about 3.15 and the slag about 2.85; so that the iron Portland cement averages 3.06 in specific gravity.

(*c*) *Chemical Composition.*—"The formula

$$\frac{CaO}{SiO_2 + Al_2O_3}$$

when calculated in chemical equivalents, shall be not greater than 2.85 nor less than 2.0."

The average of 290 works analyses of the iron Portland cement made at Wishaw shows:

	Per Cent.
CaO	59.58
SiO_2	25.03
Al_2O_3	11.04
Fe_2O_3	1.07

So that the hydraulic modulus:

$$\frac{\dfrac{59.58}{56}}{\dfrac{25.03}{60} + \dfrac{11.04}{102}} = 2.02$$

"The percentage of insoluble residue shall not exceed 1.5 per cent.; that of magnesia shall not exceed 3.0 per cent; the total sulphur content calculated as SO_3 shall not exceed 2.75 per cent. The total loss on ignition shall not exceed 3 per cent."

The average figures for the cement made at Wishaw are:

	Per Cent.
Insoluble residue	0.25
Magnesia	1.96
Sulphur as SO_3	2.35
Loss on ignition	1.0

The test for magnesia might be difficult of fulfilment in some districts where there is a considerable quantity of magnesia in the slag. The author showed in detail, in a paper read before the West of Scotland Iron and Steel Institute, that even with a highly basic slag which is used as a vehicle for removing sulphur from the blast-furnace, it is quite easy to keep the sulphur in iron Portland cement below 2.75 per cent; for much of the sulphur is lost in granulating and in drying the slag, but still more in the rotary kiln.

(*d*) *Tensile Strength* (neat cement).—"The breaking strength of the briquettes at 7 days after gauging shall be not less than 450 lbs. per square inch of section. The breaking strength of the briquettes at 28 days after gauging shall show an increase on the breaking strength at 7 days, and shall be not less than the number of pounds per square inch of section arrived at from the following formula:

$$\text{"Breaking strength at 7 days} + \frac{40{,}000 \text{ lbs.}}{\text{breaking strength at 7 days.}}\text{"}$$

The following are the average results of tests made from 8700 samples representing the first 100,000 tons made at Wishaw:

Briquettes broken at	3 days	7 days	28 days
Lbs. per sq. inch	467	635	753

Increase required from 7 days to 28 days $= \dfrac{40{,}000}{635} = 63$ lbs.

Actual increase = 118 lbs.

(*e*) *Tensile Strength* (cement and sand).—Briquettes of one part of cement and three parts of standard sand are required to give a tensile strength at 7 days after gauging of not less than 200 lbs., and to show an increase between 7 days and 28 days of not less than $\dfrac{10{,}000 \text{ lbs.}}{\text{breaking strength at 7 days}}$.

The following are the average Wishaw results from sand tests :

Briquettes broken at	3 days	7 days	28 days
Lbs. per square inch	159	253	336

Increase required from 7 days to 28 days =

$$\frac{10{,}000}{253} = 40 \text{ lbs.}$$

Actual increase = 83 lbs.

(*f*) *Setting Time.*—Unlike slag cement, it is possible with iron Portland cement to get any setting time required from a flash set to a slow set by attention to the composition of the clinker, by careful burning in a rotary kiln, and if necessary by the addition of gypsum.

(*g*) *Soundness.*—If the slag be high in alumina it is possible to make a very highly-limed clinker and yet maintain the soundness test well within the 10 millimetres allowed by the specification.

The Use of Iron Portland Cement.

It has been shown that iron Portland cement can easily comply with all the British Standard specification tests except that of specific gravity. There is apparently no reason, therefore, why it should not be used for any purpose for which Portland cement is used. In the paper already mentioned the author described a reinforced concrete chimney which was put up by the Glasgow Iron and Steel Co. as being the most exacting test to which they could put their cement. The same cement has been used for reinforced concrete in other instances and has given complete satisfaction.

For sea-water use it should be specially suitable, as the added slag provides a means of protecting any unsatisfied lime from the magnesia salts which are apt to attack concrete made with Portland cement.

There has been much confusion between the use of blast-furnace slag as aggregate for concrete and the use of cement made from blast-furnace slag. Failures in the former case have been quoted in order to disparage iron Portland cement. The following results (Table II., p. 8) show that blast-furnace slag, specially the highly basic slag which is good for making cement, may be a poor material for aggregate compared to such an aggregate as steel furnace slag; but that does not affect its use for making cement

The slag used as aggregate was of the same chemical composition as that used for the cement with which the concrete was made in both cases.

Most of the results so far quoted have been obtained in the works at Wishaw. The following figures (Table III., p. 9) have been supplied by a well-known firm of civil engineers who have used iron Portland cement from Wishaw in the construction of a quay wall on the Clyde. They made careful tests, because like other engineers they were originally prejudiced against this class of cement, and they now own to a complete conversion.

Conclusion.

Nearly all blast-furnace slags can be utilized as raw material for making Portland cement, although in

TABLE II.—*Crushing Strength of Concrete (Lbs. per Square Inch).*

Mixture.	Blast-Furnace Slag Aggregate.				Siemens Acid Steel Slag Aggregate.			
	3 Days.	7 Days.	28 Days.	90 Days.	3 Days.	7 Days.	28 Days.	90 Days.
1 Iron Portland cement + 1 aggregate . .	2625	3970	7500	8075	3600	4650	6000	5800
1 ,, ,, 2 ,, . .	1675	2650	4900	5725	3450	4775	7050	6900
1 ,, ,, 3 ,, . .	1075	1950	3250	4000	3175	4575	5850	7375
1 ,, ,, 4 ,, . .	...	2325	3200	4300	2450	3450	5375	6750
1 ,, ,, 5 ,, . .	1200	1600	2625	3750	2850	4125	3750	4850
1 ,, ,, 6 ,, . .	450	1075	2650	2700	2050	2650	4050	4400
1 ,, ,, 7 ,, . .	775	1375	2150	2225	1637	2650	3000	3050
1 ,, ,, 8 ,, . .	1150	1475	2700	2600	1325	1750	2700	3200
1 ,, ,, 9 ,, . .	400	1125	2225	1575	800	1175	1975	3050

TABLE III.—*Tensile and Compression Tests.*

Tensile Tests.

Date.	Sample.	7 Days. Lbs. per Sq. In.	28 Days. Lbs. per Sq. In.	3 Months. Lbs. per Sq. In.	Fineness, 180 × 180	Setting Time—Neat. Initial.	Final.	Expansion. Mm.	Sp. Gr.
	"Giscol"								
1919. Mar. 3	1	231	415	475	8·5	7 mins.	45 mins.	0·5	3·05
May 13	3	324	426	482	7·95	30 ,,	7½ hrs.	3	3·01
Sept. 26	6	388	489	518	..	85 ,,	7½ ,,	3	3·03
1920. Jan. 23	8	291	455	..	9·07	84 ,,	6½ ,,	3·5	3·05
	"English."								
1919. May 2	..	344	..	..	6·62	2 hrs.	5¼ ,,	2	3·175
1920. Jan. 23	7	266	347	..	10·46	62 mins.	4½ ,,	2	3·10

Compression Tests.

28 days. Mixture 1—1—3.

"English." Lbs. per Sq. In.	"Giscol." Lbs. per Sq. In.
1146	1189
907	983

Note.—This was not a test of the cement but of a particular aggregate, which was found unsuitable.

some cases a large addition of limestone would be required to increase the percentage of lime and reduce that of magnesia, etc. Only some of these slags can be used for the subsequent addition to the clinker necessary for iron Portland cement. Ironmasters who make cement will in any case have to face opposition, and it is very much to their mutual interest that, whether they make Portland or iron Portland cement, they should maintain the highest quality which has been shown to be possible, and so convince cement users that blast-furnace slag is an excellent material for its manufacture.

FREETRADERS AND THE IRON AND STEEL INDUSTRY

An Australian opinion

It is quite in the order of things that the Cobdenists of Australia should have mobilised all their forces to prosecute a campaign against the iron industry The Freetrader is a logical animal enough. He is out to crush the industrial development of the Commonwealth, and herealises that his purpose can best be achieved by crippling, if he can, the growth of the great key industry upon which, to a very large extent, the cause of the economic self-containment of Australia fundamentally depends. When the new Tariff was first published the Freetraders in our midst promptly launched a furious attack upon the Broken Hill Proprietary Company. They endeavoured to make the public believe that the B.H.P. is a gigantic monopoly, which would be certain to take advantage of the new Tariff to exploit every other industry, and to fleece the entire nation. This monstrous fabrication was presently exploded by the publication of a few indisputable facts. It was shown, for example, that the B.H.P. so far from enjoying a monopoly in the production of iron and steel, has several very active local competitors, one of whom, the firms of Messrs. G. and C. Hoskins Ltd., produces enormous quantities of iron and steel, and regularly employs almost as many workmen as the B.H.P. itself. It was shown, furthermore, that the State Governement of Queensland is on the verge of establishing State iron and steel works both in Queensland and in Western Australia, and is arranging to invest several millions sterling in the enterprise. Protectionists wondered what the Freetraders would do when the "monopoly myth" was disposed of. They have not been required to spend much time in guessing. Quickly recovering from the defeat of their first mendacious and meretricious attempt to plant a dagger in the back of the iron and steel industry our good friends, the Cobdenites, are now endeavoring to infect the public with a detestation of the principal section of the industry by parading the profits it has earned in the light of a national injustice. Wheresoever the Freetrade agitators can find newspaper hospitality, they are assailing the B.H.P. Co. on the alleged ground that since 1914 it has earned profits to the extent of £2,216,000; and they cite these figures as though they contained proof stronger than Holy Writ that the iron and steel industry is an iniquitous profiteering organisation The fact that the B.H.P. Co. and its competitors (besides facilitating the industrial development of the whole Commonwealth during the war) rendered the most signal possible war service to the nation, and, indeed, made it possible for the Commonwealth to continue fighting the Hun effectively, is always blandly ignored in these Freetrade diatribes. Freetraders also consider it beneath their dignity to contrast the profits earned with the capital invested or to mention any such unimportant detail as the fact that while a proportion of the iron and steel industry profits is distributed among tens of thousands of shareholders, the whole of the balance has been used to facilitate the expansion of the industry, so that the requirements of Australia might become eventually wholly supplied by local effort. Ignored also is the fact that locally-produced iron and steel has been, and is being, supplied to Australian consumers more cheaply than any similar foreign products. Ignored, also, is the further fact that the industry, even in its present stage of development, is providing prosperous employment directly and indirectly for many thousands of Australian citizens. The whole genius of the Freetraders, to be brief, is concentratively directed to hold up the public execration the simple fact that in five years' operations a substantial profit has been earned. That is a very terrible fault in the eye of the Cobdenists. They know, as well as any of us do, that if during the war no Australian iron and steel industry had been in existence, and Australia's requirements of iron and steel had had in consequence to be procured from abroad, the cost to the Australian nation must have been unfinitely heavier than it was. They know, in short, that in the absence of an iron and steel industry in the Commonwealth, foreign manufacturers of iron and steel would, during the five-year period mentioned, have reaped a profit from the Australian trade incomparably greater than that earned by the local industry. We should say, at a rough guess, at least twice as great, and we challenge the Freetrade party to disprove our estimate. But then, of course, this profit would have been earned by the foreigner, and that is no sin in the eyes for the Cobdenist. The Freetrader is so constructed that he regards it as an unpardonable crime for any of his fellow citizens to earn a profit out of local manufacturing enterprise, no matter what service may be rendered to the nation for that profit. On the other hand, when a foreigner makes a profit, however immense it be, the Cobdenist regards his operations as entirely virtuous, and he incurs nothing but blessings from the whole Freetrade confraternity. Little is the wonder that the typical Freetrader is held in measureless contempt by every right-thinking Australian citizen. He is the eternal crier of stinking fish. His mission in life is to glorify the alien, and to assail with vile abuse all his own kith and kin, who are not importers. The fable has it that the meanest of all creatures is the bird that fouls its own nest. The inventor of the fable, had he been a political economist, would undoubtedly have thus spoken of the Freetrade school. Many Protectionists regard the typical Cobdenist as a purblind and unteachable idiot. They make a serious blunder. The average Freetrader is no fool. He sees with perfect clarity that his doctrine is inimical to the welfare and best interests of the country in which he lives But his strange doctrine suits his own pocket, for he is an importer, i.e., in every sense save the physical he is a foreigner. "Industrial Australian and Mining Standard."

Conveying Systems

JOHN S. WATTS, New Glasgow.

Of late years, there has been developed, and placed on the market, such a large variety of conveying apparatus, of so many different types, that it is now possible to purchase a type of conveyor to suit almost any conceivable conveying problem, with almost as much simplicity as the purchase of such standard products as a lathe or planer.

The manufacture and design of conveying equipment has reached the stage where these machines are made practically as standard lines, with the excellence of design which naturally follows from continuous experience in their manufacture and operation.

This is a distinct step forward from the older practice, when every conveyor was considered as a special problem to be solved only by the operating companies' engineers, who would naturally have less experience than that of the engineering staff of a company regularly manufacturing conveyors.

The operating companies' engineers, however, still have, and must continue to have, the final responsibility of deciding which of the numerous types of conveyors will best fill their requirements.

To decide this question intelligently, requires a knowledge of the characteristics of all the various types of apparatus, a knowledge which is not possessed by the average engineer, and it is in the hope that it will be of some assistance to engineers in deciding on the right kind of conveyor, that this article has been written.

The conveying problems may be divided into two broad classes, namely, those in which the receiving point, and delivery point are not in any fixed position, and those cases in which the receiving and delivery points are fixed.

In describing the various designs of conveyors that are used, under the conditions specified, it will be understood that no reference is made to what may be considered as standard equipment that is universally known and used, such as overhead travelling cranes, man or horse-propelled trucks, wheel barrows and the like. Not that these do not require study, and are sometimes the right solution to a conveying problem, but that the intended function of this article is to give a comprehensive list of the available, but less well known and more modern conveyors, with the limitations of each type.

Taking up the first-named class of conveying problem, the requirements may be stated in general terms, as being the moving of material from any point anywhere within a certain area to any other point, which may be anywhere within the same or another given area.

If the material to be moved, consists of a large number of comparatively light parts, which can be conveniently placed in boxes or trays, after being operated upon, and are to be moved to another point in the same shop, over a reasonably smooth floor, the transporting elevating trucks, which can be pushed under the loaded box, and the load then raised by the truck a few inches clear of the floor, are the best type. These transveyors or elevating trucks are now sufficiently well known to need no further description.

When the parts to be moved are single heavy pieces, but the other conditions are as outlined in the last paragraph, the best solution is to use a portable crane, similar to that shown in Figure 1. This, of course, assuming that an overhead travelling crane is not available, or already has more work than it can handle.

If the floor of the shop is not smooth enough to allow the transveyor or portable crane to be hauled over it with a reasonable effort, or if the floor space is too confined, or if the material has to be conveyed some distance, as into another shop, the overhead trolley will best fill the conditions. An example of this type is shown in Figure 2.

While the receiving and delivery positions, are, with this last apparatus, confined to points under the line of the overhead beams, by fitting switches and junctions, in a manner similar to those used on a railway track, this system can be made to serve a large area at a reasonably low expense.

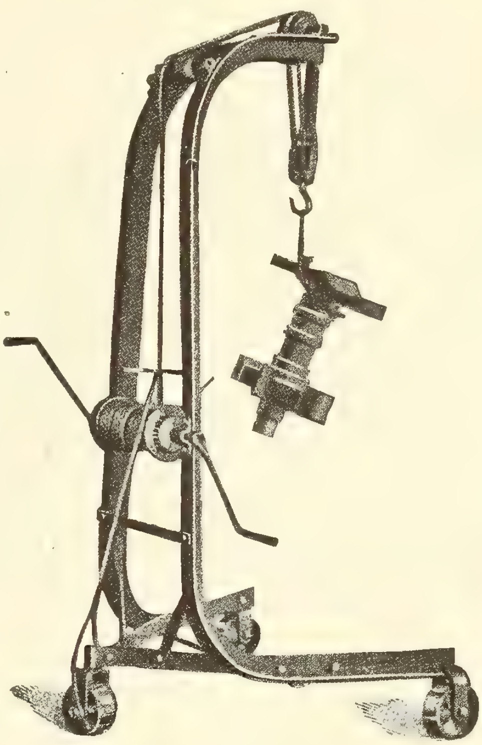


Fig. 1.

Outside of the older methods of handling material, such as trucks or cars, hauled by men or horses, electric or gasoline tractors, the above mentioned systems of conveying, represent the choice of apparatus we have, and knowing the conditions, there need be no trouble in deciding upon the right one.

The second class, where the delivery and receiving points are fixed, introduce a much greater range and variety of conditions, of material to be handled, and of equipment that may be used.

This class can be further sub-divided, in accordance with the general direction in which the material is to be conveyed, namely:

1. Vertically upward
2. On an incline upward.
3. Horizontally.
4. On an incline downward.
5. A combination of any or all of the above directions.

Taking these sub-divisions in their numerical order, we have:—

1—Conveying Vertically Upward.

The available methods are:

The lift or elevator, operated by air, hydraulic, steam or electric power. These are used, when the material is in large heavy pices, or varies in bulk and shape. The power to be used will be necessarily decided by what power is available.

The chain elevator fitted with buckets, arms or other attachments, suitable for the material. For light material, a belt is sometimes substituted for the chain, the buckets being fastened to the belt.

The choice of equipment for cases under this subdivision is practically decided by the class of material to be handled, and the problem should present little difficulty to the engineer.

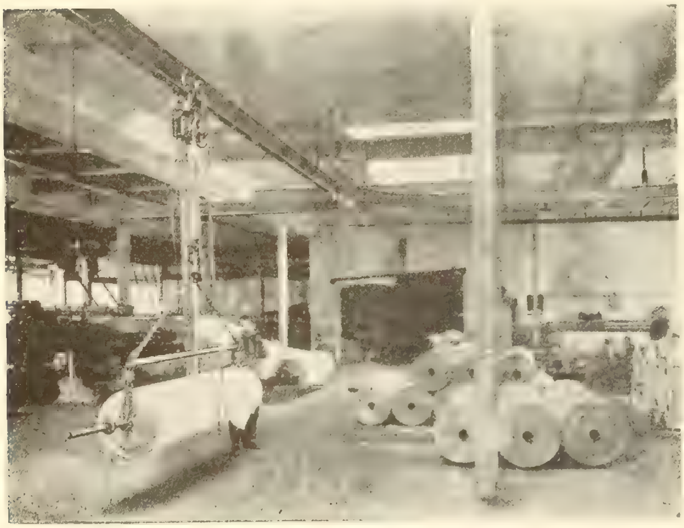


Fig. 2.

The next subdivision presents a more varied combination of conditions, and is:

2—Conveying on an Incline Upwards.

This may be subdivided further into—

2a—Conveying up an incline of 20° or more, from the horizontal;

2b—Conveying up an incline of less than 20° from the horizontal.

2a—Inclines of 20° or More.

We are compelled to use either a bucket or chain elevator, similar to those described under sub-section 1. If the grade is not too steep, the chains may be fitted with flights or scraper plates, which drag the material along a trough of steel or wood but these can only be used for comparatively fine and light material.

If the material be very light, such as sawdust, tan bark, etc. and the distance not too great a very simple type of conveyor can be used made of a wire rope with circular discs of cast iron, clamped on it at intervals, and working in a semi-circular trough.

For very long distances, a cableway must be used with a carriage travelling on the cable, and hauled up by a hoisting engine at one end.

For slopes of 20° or over those conveyors having a flat conveying surface, such as steel plate or belt conveyors, cannot be used, because the material would slide backward.

The type of conveyor to be used must be decided to suit the material to be handled. Heavy material in lumps will be best conveyed by the bucket elevator. For barrels or packages use a chain elevator fitted with the proper attachments for carrying that shape of package that is to be elevated. Light material in small pieces can be elevated by the chain with scraper flights in a trough. Heavy materials to be transported a long distance, require a cable conveyor.

2b—Inclines of Less than 20°.

Under these conditions, we have the choice of all of the types descriebd under section 2a, and in addition we have the following:

For moderately light material, we can use the rubber belt conveyor, but the material must be such that it can be delivered onto the belt without cutting or abrading it, and the weight must be low enough, not to sag the belt too much between the roller supports. Hard material must be delivered onto the belt at about the same speed, and in the same direction, as that in which the belt is travelling.

For heavy or hot material which would damage a rubber belt, we must use a steel plate or pan conveyor.

3—Horizontal Conveyors.

For horizontal conveying, we can use any of the types outlined in the previous sections, the choice depending on the class of material to be handled, and the quantity to be conveyed in a given time.

Where a large output of heavy material is to be conveyed a distance of not over about five hundred feet the bucket type of conveyor is the best. The buckets can be made of large capacity, holding a ton or more if necessary, and deliveries of one thousand tons per hour are being handled by this type with excellent results in low cost. This type can be run outdoors exposed to severe climatic conditions without detriment.

For smaller outputs of any kind of material that is not sticky and for any reasonable distance, the vibrating conveyor is most suitable, being simple and rugged in construction. This type consists, in general, of a steel trough mounted on wooden legs set at a slight angle. The trough is given a vibrating, or to and fro, motion by a crank shaft. The general idea can be seen from Figure 3.

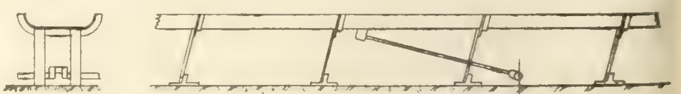


Figure 3

Some makers use rollers to carry the trough and cause the material to travel along the trough, by giving the trough a quick forward and slow return movement, by means of a link motion actuated by the crank shaft.

This type of conveyor is not as well known on this continent as it deserve to be, but is much used in Europe, and for rough hard work is a machine that will

give little or no trouble. It will elevate material up a slight grade about 2 per cent being the maximum, but depending upon the difference between the co-efficient of friction of the material, at rest and in motion.

This difference between the friction at rest, and in motion, is the basis upon which the machine depends to perform its function. The trough itself only vibrates backward and forward a few inches, while the material travels along the trough at a practically uniform speed.

When the material requires to be examined, and rock or other debris picked out, the bucket conveyor is eliminated from consideration, and a vibrating or a flat plate conveyor of either steel or rubber must used.

For fine material of a gritty nature, to be conveyed a short distance, a screw conveyor such as that shown in Figure 4, makes an easily arranged system.

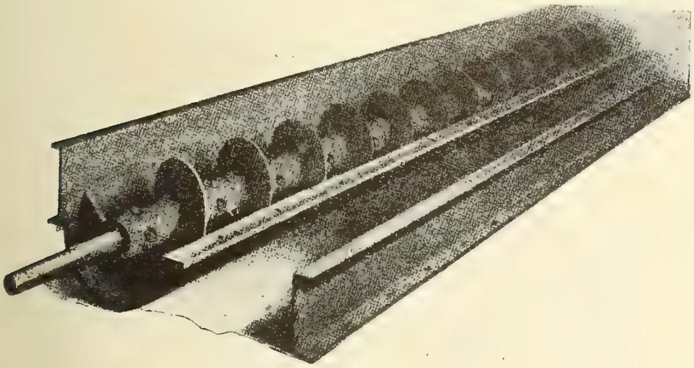


Fig. 4.

4.—Conveying Downwards

When the material is to be transported on a downward inclination, we have the choice of all of the types already described, and also some others, descriptions of which follow.

Where the downward grade is at an angle of not less than about 35 degrees from the horizontal, depending upon the co-efficient of friction of the material, all that is needed is a chute to guide the material. The force of gravity will cause the material to slide down the chute to its destination. The chute can be made straight, curved or spiral, or any shape required to join the delivery point to the receiving point, so long as the grade is not less than that needed to cause the material to slide.

If it is impossible to get an inclination of 35 degrees, the material will not slide, but one of the types of gravity conveyors can be used. These are made with sides, like a chute, but the bottom is made of rollers, which can be made of any shape or size to suit the material to be handled. The material must be nearly uniform in cross section, and must be long enough to span over at least three rollers.

When the inclination is not less than ten degrees from the horizontal, and the material such that it cannot be handled by a roller gravity conveyor, a shaking chute will deliver the material.

This is simply an ordinary chute, suspended by eyebolts, and given a shaking movement, backward and forward in the same direction as the flow of the material, of some four or five inches, by eccentrics driven by a revolving shaft running at fifty to ninety revolutions per minute, depending upon the inclination of the chute, and the friction of the material on the chute bottom.

If the material will float in water, or is fine enough to be carried in suspension by a current of water, the hydraulic flume may be a simple solution. This is merely a stream of water carried in a wooden trough, and where ample water is available provides a cheap method for the disposal of ashes.

A Unique System of Ash Disposal.

A very economical method of ash disposal is in vogue at the Wabana Iron Mine at Bell Island, Newfoundland. This island is situated in Conception Bay, and the bay is frozen over every winter.

The power house is situated on a wharf at the water's edge, and the wharf is equipped with a coal handling tower, which has a crane on it, handling a grab bucket, by means of which the coal is unloaded from steamers in the summer season.

In the Winter, the ashes are allowed to accumulate on the wharf until the ice commences to break up and drift out to sea. When this occurs there is a continuous procession of large ice cakes passing the wharf for some days, and as each cake passes the wharf, the grab bucket picks up a load of ashes and deposits it on an ice cake, which the ice carries out to deep water before it melts.

In any of the above types, the loading point can be placed anywhere on the line of the conveyor. The delivery point on the large bucket conveyor, is of necessity at the end of the conveyor.

The smaller bucket conveyors can be arranged to deliver at any point, in a horizontal part of the conveyor, by having a moveable tripper, which will upset the bucket at any desired point.

The rubber belt conveyors can also deliver at any point in their length, by the use of a moveable tripper, which is, however, a rather expensive and complicated piece of mechanism.

The flat plate steel conveyors, can only deliver at the end of the conveyor.

The chain conveyors, and vibrating conveyors, can deliver at any point in their line, by having gates fitted in the bottom of the trough at the desired delivery points.

The vibrating conveyor has the further advantage that by using perforated plates in the trough, it can deliver various sized products at various points.

5—Conveying in both vertical and horizontal directions or any combination of indications.

This division requires further subdivision, as follows:—

5a—Where the centre line of the conveyor is always in the same plane.

5—Where the direction of the flow may be changed sideways, as well as changing in inclination.

5a.

This constitutes the cases where the material has to be conveyed at varied inclinations, but in plain view the centre line of the conveyor will be a straight line.

With limitations depending upon the inclination, all of the conveyors described in the previous sections can be used, if the conditions specified in the other sections are not violated.

The steel plate type of conveyor would require a separate conveyor for each change of direction. That is, we could arrange a conveyor running up one incline, and delivering its material to another conveyor running on a different incline. The other types can change their direction without difficulty in one plane.

5b.

As in section 5a, all the types will fulfil this condition more or less easily, but require as a general thing, a complete conveyor for each change of direction that is not in the plane passing through the centre line of the conveyor.

However, there are a few types which can accomplish the conveying of materials in a tortuous direction, more simply if the conditions are favorable.

For heavy material, over long distances, the cableway is the most flexible apparatus.

For light material, such as shavings, sawdust, etc., a blower, will blow this material through piping in the most contorted construction, given pressure and capacity sufficient but is limited somewhat as to distance.

For conveying small parcels, in any direction, a lead pipe is used, of about 3 inches diameter, with a circular carrier made to fit it, and having a felt disc to make it airtight. This carrier is forced through the pipe by air pressure of about ten pounds, or sometimes a vacuum is used of the same amount. The carrier will convey anything that can be placed in it, and will travel around a radius of as small as twelve feet.

BOOK REVIEW

A METALLOGRAPHIC STUDY ON TUNGSTEN STEELS. By Axel Hultgren, John Wiley & Son, Inc. Cloth Boards. 6 by 9 inches, 95 pages and 76 reproductions of microphotographs.

The metallographic investigations recorded in this treatise were originally undertaken at the Institute of Technology at Charlottenburg, Germany in 1913 and 1914. They were further developed and completed during 1914 to 1918 at the Royal Institute for Testing Materials in Stockholm, and in the laboratory of the SKF Ball Bearing Co. at Gothenberg, Sweden. The original Treatise was written in Swedish in 1918, and as an appendix to the work there appears a critical review of the investigations of the Japanese collaborators Honda and Murakami, with which the author of the treatise was unacquainted until the completion of his own investigations. The investigations made in Tokio include studies in the equilibrium diagram, the microstructure and transformations of tungsten steels, and are commented upon by the author in this order.

Mr. Hultgren's work consisted of the heating and cooling of many specimens, the recording of curves and the preparation of microphotographs, which occupy about half the space in the volume, and are of excellent workmanship. The book is one for the advanced student of metallurgy. A complete review of the work of previous investigators is included. The treatment of the subject is divided into two sections, namely (1) the transformations of tungsten steels during the different heat treatments, and the stuctures thereby formed; and (2) Carbides in tungsten steels, supplemented by a short note on carbides in other alloy steels.

AN OCCURRENCE OF NICKEL IN SOUTH AFRICA

The South Africa Journal of Industries contains a report from the Inspector of Mines for the Pretoria District, on the occurence of nickel ore in the Barberton District, on the property of the Scotia Talc Mine. The discovery of the ore was accidental. The footwall of the bed, which is 2 ft. 3 inches in width and dipping 6 degrees, is a fissile sandy rock "which may be described as phyllite". The footwall is a decomposed sandy rock, also shaly in structure and showing some green stains. A sample analysed contained 25.8 per cent of nickel. The analyst's report states that as sulphur and arsenic are absent the ore is probably a mixture of magnetite and a nickel silicate. A representative sample taken across the bed at about three feet below the surface gave 17.2 per cent nickel, and a similar sample taken over 1 ft. 3 in. of the footwall gave 1.67 per cent.

In the talc mine, which the nickel occurence geologically underlies, a sample of the residual limonite, which results from the leaching of the talc, assayed 1.42 percent nickel, from which the Inspector deduces that nickel is comparatively widely diffused in the neighborhood.

The extent of the deposit is not indicated, and enquiries are being made as to the marketable value of the ore.

JAPANESE STEEL MERGER

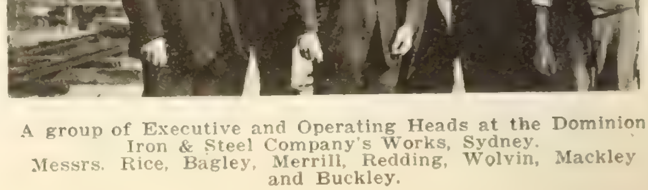
Amalgamation of all the steel works in Japan, in order to tide over the present trade conditions, is reported under consideration by the Japanese Government, the authorities of which are said to be investigating the possibilities of a nation-wide merger.

The iron market continues weak, owing to the slump in quotations and the decrease in demand, although the amount of iron imported from the United States aggregates nearly 2,000 tons a month in accordance with the contracts signed last year.

In these circumstances, pessimistic views are being now entertained by some of the iron dealers, and a number of the steel works have been obliged to close. The output for the first half of the current year, therefore, is expected to result in a decrease of nearly 30 per cent, with even worse prospects for the latter half of the year.

COMMENCE WORK ON DOMINION STEEL'S NEW COKE-OVENS

About 120 men are employed on the excavatory work for the new 60-oven Kopper's type battery at the Dominion Steel Corporation's plant in Sydney.



A group of Executive and Operating Heads at the Dominion Iron & Steel Company's Works, Sydney.
Messrs. Rice, Bagley, Merrill, Redding, Wolvin, Mackley and Buckley.

The More Economical Utilization of Coke-Oven and Blast-Furnace Cases for Heating and Power

By G. W. HEWSON and S. H. FOWLES.

Use of Coke-oven Gas.

The following have been taken from Brame's "Fuel" as average figures obtained on several classes of work, and the authors consider they represent good average working :—Steam : Steam raised per lb. of coal carbonised, 1.25 lbs. Steam required per b.h.p. ; reciprocating engines 15 lbs. per b.h.p. ; turbines 11 lbs. H.p. per ton of coal=187 and 255 respectively. Coke-oven gas : Surplus gas per ton of coal carbonised 5,000 cubic ft. at 500 B.T.U. Heat units required per b.h.p. 9,500 (27 per cent. efficiency). H.p. per ton of coal=266.

In tests made at Messrs. Cockerills, 1 kw. at the terminals consumed 35.3 cubic ft. of coke-oven gas at 450 B.T.U., approximating 9,000 B.T.U. per b.h.p. on the gas engine with 95 per cent. efficiency of the generator.

Dr. H. G. Colman gives the consumption with 458 B.T.U. gas on a Nurnberg engine of 1,200 h.p. at 100 r.p.m. as 21.3 cubic ft. per b.h.p. equalling 9,750 B.T.U. per b.h.p.

These results were actually obtained on long runs quite apart from test figures, and give quite a good lead to the internal-combustion motor over other prime movers.

On the basis of 8,000 cubic ft. of coke-oven gas required for making 1 ton of steel and 4,300 cub. ft. for reheating furnaces per ton of steel, the quantity of coke-oven gas potentially available is sufficient for about 8,000,000 tons of steel per annum.

The purpose for which surplus coke-oven gas is actually used is largely dependent upon the location of the ovens. The demand for such gas may be sufficiently great in some instances to make the gas a more important product than the coke. In such cases the plant would actually be a by-product gas plant.

Blast-Furnace Gas.

The relative proportion of blast-furnace gas made and utilised profitably in Germany and this country in 1911 was :—

	Germany b.h.p.	England. b.h.p.
Producible	1,340,000	1,000,000
Utilised	448,000	23,000

The quantity of gas produced in a blast-furnace using coke as fuel is usually considered as approximately 150,000 cub. ft. per ton of iron produced; this may be materially increased if the blast furnace is considered as a gas producer, since the use of blast-furnace gas for the production of power, and its more economical use as fuel gas, has materially altered the necessity for economy in the use of coke in order to keep down the cost of manufacture of pig-iron. It has been demonstrated that by a more intensive working of blast furnaces by increasing the coke in the charge, and, incidentally, the yield of pig-iron, blast-furnace gas could be improved in calorific value. Practical trials have shown that by increasing the coke 18 per cent. an increased yield of 7 per cent. is obtained without affecting the quality of the iron, together with 15 per cent. larger volume of gas, with its calorific value raised 12 per cent., the heating power of the total gas produced being increased 25 per cent. Hitherto all the gas produced by a blast-furnace plant has been utilised on that plant alone, and in some cases has been augmented by the use of coal on boilers to raise steam for the blowing engines and auxiliary plant.

With modern and more efficient modes of utilisation at least 50 per cent. of the gas is released for purposes outside the blast-furnace requirements. This is equivalent to 25 per cent. of the heat value of the coke charged into the furnace. This economy results from the higher temperature attainable in the stoves by means of a smaller consumption of gas. Compared with stoves working on dirty gas, and requiring 50 per cent. of the gas produced by the furnace, modernised stoves working on clean gas have given high temperature to the blast over longer periods, with a consumption of 28-30 per cent. of the gas produced. In spite of the loss of the sensible heat of the gas, and allowing 12 per cent. for the blowing engines and 8 per cent. for leakage, losses, etc.. there is available for power generation or other purposes 50 per cent. of the gas made. If, however, the blowing engines are not gas driven, then the quantity available will be reduced considerably, if not entirely wiped out.

Increase of our knowledge of blast-furnace gas should give an impetus to the construction of internal-combustion engines and turbines. The most recent guarantee figures for large water-tube boilers give about 218 cub. ft. of blast-furnace gas at 100 B.T.U. per cub. ft. as the lowest requirements per kilowatt generated with turbo-generators, which gives a thermal efficiency of 15.5 per cent. over boiler, turbine, and generator; while to-day, with gas engines at 10,000 B.T.U. per b.h.p. hour it is possible to get an efficiency of 25.5 per cent.

The greater efficiency of the gas engine more than compensates for the loss of sensible heat due to the necessity of cooling the gas for the engine, against retaining it for boiler use. It has been computed that on an average about 7 per cent. of the heating value of the gas is lost by cooling it. Taking one cub. ft. at 100 B.T.U. cooled for engines, we get (100—7) x 25/100=23.25 useful B.T.U. in the engine; hot gas for for boilers gives 100 x 15/100=15 useful B.T.U. in the turbine. Comparing the thermal efficiency of gas engines with steam turbines, we see what a saving can be effected by the former, and this points to the importance of installing the most efficient machinery to utilise the gases evolved from the blast furnaces of the country.

	Efficiency. Per cent.	Cub. ft. blast-furnace gas required to give 1 theor. h.p.
Large gas engines	25	114
Large turbines with boilers.	15	190
Small turbines with boilers	12.5	228

From a national standpoint, it would be better to harness all the potential power of the 300 blast furnaces at work in this country and, linking up with existing power companies, supply the country with a large proportion of its requirements at a more reasonable rate than is at present possible with stations using coal-fired boilers and turbines. It has been

Abstract of Paper read before the Society of Chemical Industry during July.

stated recently on high authority that if the steam turbine be increased from what is considered a reasonable size to-day, viz., 15,000 h.p., up to 60,000 or 70,000 h.p., the steam consumption can only be reduced ½ lb. per kw. generated, which is a very small amount compared with the increased size of unit. This large size of unit has another great disadvantage, that with a station of two such units and one set fails serious inconvenience will be caused, even allowing for the possibility that such a plant may be linked with the greater scheme. Again, some of these larger stations may be built at a distance from the coalfield, and this will not mitigate our transport difficulties.

In order to emphasise the superiority of gas engines over boilers and turbines, Tables I, II, and III. of comparative costs are given, starting with the same cost of preparation of the gas.

TABLE I.—Cleaning 3,000,000 cub. ft. of gas per hour by the Halberg-Beth plant.

First cost of plant, £62,000.	£	
Interest at 7 per cent.	4,340	
Depreciation at 10 per cent.	6,200	
Power and light at 35 kw. per mill. cub. ft. and 0.5d. per unit	1,860	
Plant labour costs	1,664	
Dust house costs	1,560	
Supervision	300	
Repairs and stores at 6d. per mill. cub. ft.	638	
Renewal of filter bags, one set per		
Less cost of stove cleaning and lining	3,360	
annum	900	
Steam for reheating 0.2 lb. per 1,000 cub. ft. at 2s. per 100 lbs.	510	
		£17,972
Less cost of boiler and flue cleaning	1,594	
Less cost of stove cleaning and lining	3,360	
Less revenue from sale of dust	4,411	
		9,365
Net cost of gas cleaning per annum		8,607
Cost per 1,000 cub. ft. 0.081d.		

TABLE II.—Cost of Generating 1 B. of T. U. of Electricity from Blast-furnace Gas, using Gas Engines.

First cost of engines, £55,000.	£
Interest at 7 per cent	3,850
Depreciation at 10 pr cent	5,500
	£9,350
Load factor 40 per cent.	Pence.
Engine cost per unit	0.102
Value of gas used	0.075
Cleaning of gas	0.012
Labour	0.055
Maintenance	0.008
Oil and stores	0.054
	0.306

TABLE III.—Cost of Generating 1 B. of T.U. from Blast Furnace Gas, using Boilers and Turbines.

First cost of boilers and turbines, say 75 per cent. cost of gas engines, £41,250.	£
Interest at 7 per cent.	2,887
Depreciation at 10 per cent.	4,125
	£7,012
	Pence.
Engine cost per unit	0.078
Value of gas used	0.109
Cleaning gas, 218 cub. ft. at 0.081d. per 1,000	0.017
Labour	0.110
Maintenance	0.016
Oil and stores	0.054
	0.384

By building coke ovens near the blast furnaces and steelworks upon the regenerative principle, about half the gas generated can be utilised for the latter. Further surplus gas might be released if the ovens were fired with gas produced from inferior fuel, unsuited for other purposes than conversion into producer gas.

TUNGSTEN ORES: IMPERIAL INSTITUTE MONOGRAPH.

The monograph on tungsten ores in the series of Imperial Institute Monographs on Mineral Resources, which has just been published by Mr. John Murray, has been prepared for the Mineral Resources Committee by Mr. R. H. Rastall, M.A., F.G.S., University Lecturer in Economic Geology, Cambridge, and Mr. W. H. Wilcockson, M.A., F.G.S., Lecturer in Geology in the University of Sheffield. It is divided into three chapters, the first containing a general account of tungsten ores, their characters, occurrences and origin. their mining and concentration, valuation and price, with a brief description of the metallurgy of tungsten and its employment in steel manufacture and other purposes, with a short discussion of the composition and characters of the remarkable non-ferrous alloys of which it is a constituent. The second chapter contains a detailed account of the geological features of tungsten deposits, and the mining and production of tungsten ores within the British Empire, including numerous statistical tables of output; while in the third chapter the tungsten resources of the rest of the world are treated in a similar manner. The relations of the British Empire and United States output to the world's total and the production of tungsten ores in the chief producing countries of the world are also shown by means of graphs,

The table giving the world's production of tungsten ores for the years 1910-1917, arranged by countries, shows that the British Empire produces a very large proportion of the total supply. Until about 1910 the United States headed the list, but about that time Burma rapidly came to the front and for several years showed the largest total. In 1916 the United States experienced an extraordinary tungsten boom, when prices soared to unprecedented heights and production was greatly stimulated. This in its turn stimulated the production in various South American States, especially Bolivia and Argentina. Before the war the smelting of tungsten ores was mainly in German hands, and the greater part of the British ore was sent to Germany for treatment. The enormous development of the manufacture of munitions in this country and elsewhere led to a great demand for high-speed steel for cutting tools, and a syndicate of thirty of the largest steel manufacturers at Sheffield formed a company to undertake the preparation of tungsten metal at Widnes. This company also acquired an important mine in Burma. The manufacture of metallic tungsten and of ferrotungsten was also undertaken on a large scale by several other firms in this country, in order to provide high-speed steel and other products

for the needs of the British and Allied armaments. In order to ensure a sufficient supply or ore and to regulate the markets, the export of tungsten ore from within the Empire to foreign countries was forbidden by agreement of the various Governments concerned and the price was controlled. At first the rate was fixed at 55s. per unit (1 per cent of WO_3) per ton for concentrates of 65 per cent, and upwards, afterwards raised to 60s. per unit. This usually worked out to about £200 per ton for good average concentrates. As was naturally to be expected, the world's production of tungsten increased largely during the war years, rising from 8,000 tons or thereabouts in 1914 to over 20,000 tons in 1917. One of the most remarkable features was the sudden development of output in China, from sources of which little is known, the output for 1918 being over 4,000 tons.

In the British Isles wolfram is a by-product of the tin mines of Cornwall, and the big demand for it proved of great importance to many of these mines. Strenuous efforts were made to keep up the output of both metals in spite of scarcity of labour owing to the demands of the army authorities for men. Several promising new occurrences were developed, and old ones resuscitated. By far the most important feature of the Imperial production of tungsten in the last few years was the great development of the Tavoy district in Tennasserim, Lower Burma, which in 1917 exported no less than 4,553 tons of concentrates. The greater part of this appears to be from various forms of superficial deposits, though lode-mining is now making important progress. In the Malay States, both Federated and Unfederated, as well as in the intervening Siamese territory, the geological conditions are very similar, though here tungsten is subordinate to tin. An important quantity of ore also comes from Queensland and New South Wales, with lesser amounts from Tasmania and New Zealand, the latter Dominion producing mainly scheelite. Some unimportant resources have also been discovered in South Africa, especially in Rhodesia.

The chief European producer in Portugal, while large resources undoubtedly also exist in Spain, where the geological conditions are very similar. In both these countries methods are primitive and often wasteful, and a good deal of smuggling undoubtedly went on during the war.

The tungsten resources of South America are undoubtedly very large, the ore occurring in large quantities along with tin in the mineralised belt of the Andes, especially in Bolivia and Peru; this appears to be of Tertiary age, while the tin-tungsten ores of Western Argentina are of much earlier date, being associated with Palaeozoic granites. The mines of Argentina before the war were controlled by German interests.

The tungsten ores of the United States, situated mainly in Colorado, California and Nevada, show a remarkable contrast to those of the rest of the world, in that they are not associated with tin. The largest producing districts of all are Boulder County, Colorado, where the ore is wolframite, and the Atolia district of California, where it is mainly scheelite. The third producing State is Nevada, while smaller quantities have come from Arizona, Utah, Idaho, Missouri, Montana, South Dakota and Alaska. In the latter only the ore is associated with tin.

The foregoing brief summary indicates the sources from which at the present time supplies of tungsten ore are mainly obtained. Occurrences of little or no commercial importance in many other parts of the world are briefly touched on in the monograph, because in some they show points of scientific interest, and some of them may in the future be found worthy of further development. From a detailed study of the geological features of all known occurrences, one point stands out clearly, namely, that tungsten ores almost invariably owe their genesis to masses of intrusive igneous rock, in nearly all cases granite. Exceptions to this rule are few and important. Almost all the important occurrences are associated with tin, and commonly accompanied by ores of copper, arsenic and molybdenum. It is a curious fact that the world's largest producing districts in Colorado and California should be almost the only exceptional and unusual occurrences.

The monograph concludes with a bibliography giving references to all the important publications on tungsten ores that have appeared up to the end of 1918.

VENEZUEALAN IRON ORE DEPOSITS TO BE MADE AVAILABLE BY IMPROVEMENTS ON THE ORINOCO RIVER

President Gomez of Venezuela has announced as one of his major plans for internal development the improving of navigation on the Orinoco River. This magnificent internal waterway, comparable in volume to the Mississippi and penetrating several hundred miles into the Venezuelan "hinterland," has been practically unavailable except for local transportation by reason of persistent and shifting sand bars at its mouth. These prevent the entrance of ocean steamers which otherwise can proceed several hundred miles into the interior beyond the well-known iron deposits of Imataca. These deposits have been under control of several American concessionaires since the early nineties. At one time the railroad contracting firm of Grant from Minnesota held the concession and planned extensive operations which were never realized, however, chiefly because of financial conditions in the United States. Later Schwab interests made an endeavor to secure the concession but failed by reason of disagreements with the Venezuelan authorities. Later, about 1910, the property came into control of a Canadian syndicate and more than $2,000,000 was spent in developments and improvements. Shipments were begun to Philadelphia and two cargoes of ore, hematite running 64 per cent and better, were delivered. A line of freight boats was provided for the business. However, difficulties with the organization at the mines, due partly to climatic conditions, and somewhat to a lack of understanding of the problems of operation in a foreign tropical region, prevented the successful continuance of the development. The great difficulty, however, was due to the obstructions to river navigation which had not been fully realized and which were of such a nature that the required improvements could not be advantageously undertaken by a single industrial enterprise. It was necssary to load the ore on shallow barges and transfer a long distance to the ocean boats on which it was reloaded in open sea practically. The Canadian endeavor was a complete failure financially and for nearly 10 years no attempt has been made to realize these large, rich and geographically near iron deposits. In the meantime the Schwab interests took up in the very distant Chilean iron deposits and have expended up-

ward of $15,000,000 on their equipment and development. Shipments were begun in 1914, but have been since suspended owing to war conditions. Large American interests have secured extensive iron deposits in Brazil and probably will soon undertake their operation to supply the European and the Atlantic Coast demand in the United States. Continued large shipments of iron ore from Cuba indicate the demand and need of a foreign supply available by ocean freight to the Atlantic plants.

It is likely that the proposed Government improvements to navigation n the Orinoco will soon again bring to realization the Imataca iron deposits of the Orinoco.

LINK-BELT "LEWIS" HOIST FOR FURNACE DOORS

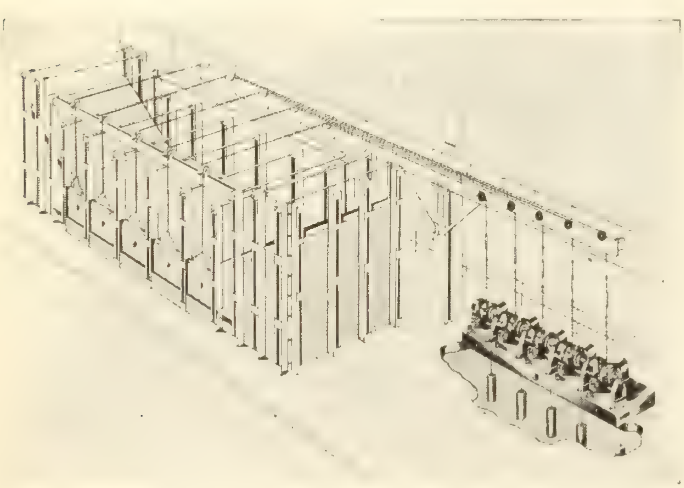
Development of a fool-proof hydraulic system of raising and lowering heavy doors such as are used on open hearth and heating furnace work, is announced by the Link-Belt Company.

Doors thus operated, it has been demonstrated, always go up to the proper position and always go down to the proper position, no matter what the weight.

The first installation of this system, made at the plant of the Allanwood Iron and Steel Company, Conshohocken, Pa., has been in continous operation for fourteen months without any repairs, attention, or maintenance expense whatever. Five hoists, with an automatic release, are used.

On each hoist is mounted a pair of chain sheaves attached to a worm wheel shaft between two flanges which are pinned to the shaft and supplied with fibre friction surfaces on the sides towards the sheaves. The worm wheel is driven by a worm mounted on a shaft of a reversible motor, the worm and wheel being inclosed in suitable housing.

To raise the furnace door, the motor is started in the direction which will pull down on the left hand chain. So long as the counterweight continues its pull, the sheaves squeeze out against the flanges, and are thereby driven in the direction which will wind up the left hand chain, and thus lift the door.



General Arrangement of Hydraulic Hoists for Furnace Doors.

The right hand sheaves has a fixed top on its periphery, so located that it will come in contact with a stop on the bottom casting when the furnace door has reached its proper height. With the motion of the right hand sheave arrested by this stop, the shaft cannot rotate the left hand sheave further, because the squeeze between the sheaves and friction flanges is relieved. There is no opportunity, therefore, for overwinding, and if through carelessness the current is not shut off promptly, the shaft with its flanges will simply continue to revolve in sliding frictional contact with the sheaves, but without the power to grip and rotate them further.

For lowering, the doors the direction of the motor is reversed, and practically the same process repeated, except that in this case the power of the motor is used to lift the counterweight, while the pull from the weight of the door serves to keep the sheaves squeezed apart against the friction flanges, until a stop on the left hand sheave engages with a stop in the bottom casting and prevents over-winding of the counterweight chain in this manner as described for the other sheave.

The stop features do away with the automatic electric switch devices which have proved so troublesome for this type of hoist, as well as for skip hoists; and they secure an exact stop for all such hoists without involving failure from human carelessness or complicated electrical equipment. The motor is started, stopped or reversed, and the door raised or lowered, by simple push button mechanism.

Various other applications of this device may suggest themselves. Literature on this hoist is available from the manufacturers.

TO BURN PULVERIZED ANTHRACITE

Rapid progress is being made on the erection of the coal pulverizing plant at the Mt. Vernon Street Station of the Philadelphia Rapid Transit Company.

This plant which at present is equipped with twenty 375-H.P. Babcock & Wilcox water tube boilers and has been producing about 75,000 K.W. hours of electric energy, is being changed to powdered coal firing, using river and buckwheat anthracite coal.

The needed output of the plant will be obtained with but ten boilers, using powdered coal, as compared with the twenty formerly required for hand firing.

The fuel after being dried and pulverized, is to be transported through four-inch pipes to a sub-divided totally enclosed bunker, located between the banks of the boilers.

From this bunker, it will be fed in controllable quantity into specially designed combustion chambers where the required air for combustion also under close control will be added.

In the coal milling plant a blow tank unit of five tons per charge capacity equipped with a quick reading scale is now in the course of erection. By compressed air the fuel is delivered to the bunker and correct fuel records obtained for each boiler. Switching valves appropriately located along the fuel distribution line will deliver the coal to any desired section of the bunker.

Three thousand pounds of coal per hour is the capacity of the feeding and burning equipment of each boiler.

It is expected that the first of the boilers will be in operation during September.

The entire equipment is being furnished by the Quigley Furnace Specialties Company, 26 Cortland St., New York City, and erected under the supervision of their engineers.

THE TREND OF COMMODITY PRICES AND WAGES.

By B. K. Sandwell in the "Journal of Commerce."

The outlook for the general trend of commodity prices today seems to be recession of more or less sharpness between now and the end of 1920, followed by a rise to even higher levels in 1921. The recession will of course be of different extent in different classes of articles, but it is likely to be fairly widespread because it is the result of curtailment of credit forcing upon the market a large part of the stocks ordinarily constituting the reserve of whosale supplies and the materials "in process" of manufacture.

The main original cause of the rise of prices is now at an end. It was as everybody knows, the creation of vast quantities of additional currency and bank credit (the two are much the same thing in their economic effects) by the suspension of gold payments and the sale of national bonds. But while the cause itself is at an end, its effects are not yet completed. Certain classes of prices are slow to be effected, and go on moving long after the general impulse has been withdrawn. We have an example of this today in the railway rate situation. Railway rates under government control are among the slowest things to move upwards, but when they do move they necessarily precipitate a further move in every price in which they form a part—that is, of the price of practically every article of human consumption.

The first increase in the supply of money is not immediately followed by an increase in prices. There is a brief interval during which the result takes the form merely of a superfluity of credit. We saw this on several occasions throughout the war, and we should have seen it more clearly, but for the rapidity with which the governments employed and expended credits which they created. We are now at the stage of a precisely corresponding hiatus at the other end of the economic process. We see the amount of money and credit becoming stationary, while the increase of prices continues, causing a backwash of precisely the opposite character. The amount of credit becomes inadequate for the volume of business at the last reached level of prices, and business is constricted at one of its most sensitive points—its range of bank accommodation. There is only one possible result from this, namely forced sales, a curtailment of manufacture, a temporary lowering of prices and a subsequent upward reaction when the shortage of production makes itself felt.

The public is as little to be congratulated upon any reduction of prices (outside the range of undoubted luxuries) which may occur this summer and autumn, as upon the freight tie-up in the States, the adverse exchange situation or the coal uncertainty. Each and every one of these things is a deterrent and hindrance to business—and business is nothing in the world but the production and distribution of the things the world needs. A price reaction this summer, or even a credit restriction without price reaction if that were possible, will simply put further limitations upon the output of needed articles and enable their producers to put one grand final addition to their cost in 1921. The struggle to settle the question, who is to get the benefit of the last and crowning increment in the price level will be keen and determined. At present it looks as though the organized

workers in certain "key" industries, notably transportation, would be the winners of the last hand in the game. If so, they will establish themselves in an immensely strong position for the period of delivering prices. He who gets his renumeration fixed on the basis of the very highest price level of the rising period will be able to keep it well above the declining levels of subsequent years.

It is impossible to foresee an ending reduction of prices in Canada in the next few months, unless other nations have large supplies of goods to sell us and are willing to give us credit for them. We cannot possibly buy more than we are doing from the United States without putting the exchange rate further against us—unless the Americans will sell to us and leave the purchase money in Canada. Great Britain might sell to us and charge our purchases against the foodstuffs, which she buys from us; but lack of shipping and the need for keeping up her relations with other markets are against any heavy increase in our purchases from her.

As for the supply of goods in Canada itself, the available stock now on hand is not large in proportion to needs although it is large (at present prices) in proposition to the volume of credit available for financing it. The cost of replacing it will almost certainly be higher than it has been at any stage of the present rise, owing to the new freight rates and the increasing burden of taxes. Liquidation of the wage level is the only hope for reducing costs in 1920-21, and will any body affirm that the time is ripe yet for that?

Meanwhile bankers assert that the emigration of European workers who grew rich here during the war is beginning to have a serious effect upon bank deposits, it will not be wholly offset by the funds brought in by immigrants from impoverished Europe.

THE EFFECT OF SHORTER WORKING HOURS ON PRODUCTION.

The effect of shorter working hours on production is the subject of a special study by the United States National Industrial Conference Board (Research Report No. 27: Hours of Work Problem in Five Major Industries.) The investigators reach the conclusion that allowing for variations in managerial efficiency a shorter working day increases the efficiency of workers who are called upon to use intelligence at their occupation; but, in factories where the product results automatically from mechanical processes production is reduced in the same ratio as the working day. From this point of view no uniform schedule of hours, equally adapted to all industries, is recommended; shorter hours are conceded to skilled workers to enable them to concentrate their minds with greater efficiency while at work, but efficiency requires no such consideration for "automatic" workers. For example, in the boot and shoe industry, which calls for the exercise of skill, it was found that maximum production could be obtained on a schedule substantially less than 54 hours per week. In the metal-working group it was found that a 50-hour week could be introduced in some trades with no loss to production, but that no such rule could be applied throughout the entire group. Similarly, output in the silk industry was maintained after a substantial reduction of hours. On the other hand, the cotton textile industry of the northern states showed that reductions of the working week to 56 hours involves a proportional reduction of output; while in the woollen manufacturing industry reduction to a 54-hour week resulted in a similar loss but less marked decline. No definite relation could be traced in any of the five industries under review between changes in wages and rate of production, but the investigators found some evidence of improved efficiency as the result of payment of a bonus, and in the piece-rate as compared with the day-rate system of wage payment. The information secured by the inquiry was not found sufficient to base upon it general conclusions as to the effect of shorter hours on the health of the workers.

From the June "Labor Gazette."

EDITORIAL

The Steel Trade and the Tariff Enquiry

THE iron and steel industry in Canada, with all its long train of antecedent and precedent interests, will shortly be made the subject of attack by advocates of tariff abolition, and will be required during the successive sessions of the Tariff Enquiry Board that are planned between now and the opening of the Houses at Ottawa, to give reasons for its existence and for the continuance of protection by import tariff.

Canada is not singular in its possession of convinced adherents of the free trade heresy, nor in the belief among certain non-industrial groups that a fiscal policy devised to suit the temporary requirements of a small and geographically central island, is suitable for any conditions under which the descendants of emigrants from that Island may reside.

A determined attack on protective tariff in aid of the steel industry in Australia is now in progress. The conditions, geographical, economic and social, of Great Britain, Canada and Australia, could scarcely be more dissimilar, yet there are those who believe, and would force others to believe, that free trade is a sovereign and inherently righteous policy applicable to all three countries.

There is no part of the British Empire, however, that is so unsuited for application of free trade principles as Canada, in its present stage of development. Canada is a continental area, only partially known, and containing only one-twelfth of its ultimate population. It lies alongside a friendly country that is opulent, powerful and enterprising beyond all previous historical precedent, with exchanges of industrial products facilitated also beyond all prior parallel by a hitherto unattained perfection in transportation facilities, and international financial combinations.

No advocate of free trade in Canada has ever explained how the industrial advantages possessed by the United States on the American Continent can be offset except by protection of home industries through equalising protective import duties. It has not been shown that the principle of free trade was applicable to Canada, nor have any of the political parties that from time to time have coquetted with the idea, ever dared to apply the principle of free trade in practice, because they knew the inevitable result.

We would distinguish between the incurable free-trader and the advocate of lower duties. The first named is not a reasoning being, and time is wasted in discussing the Canadian situation with him. The advocate of lower tariff is one who accepts the necessity for protection, but thinks the tariff is open to modification. It is the last named that the steel companies will have chiefly to combat, and we would review some of the reasons that suggest the tariff in connection with the steel industry should not be lowered at this time. We believe the abolition of the protective duties will not be seriously urged by any seriously-minded person.

Adverse Exchange and Import Tariffs Have Not Checked Imports of Iron & Steel.

THE tariff as a deterrent of importations has been for some time relegated to a second place by the discount on the Canadian dollar. The operation of economic law has — without the intervention of legislation — placed our dollar at a discount, a process that will, by restriction of imports, gradually restore our dollar to exchange parity. A reduction of import duties under these circumstances would be an entirely gratuitous and foolish proceeding, and would indicate that Canada was neither anxious to encourage home industry, or to support her foreign exchange rates.

The value of imports of iron and steel into Canada have averaged during successive five yearly periods since 1898 to 1919 inclusive, as follows:

	In Millions of Dollars
1896 to 1900	17
1901 to 1905	37½
1906 to 1910	51
1911 to 1915	99
1916 to 1919	169

The iron and steel industry in Canada may be said to have commenced in the period between 1901 to 1905. Since 1901 the value of imports of iron and steel has risen from 25 million dollars to 182 million dollars in 1919, or by six times.

From which it would appear that if a check on im-

ports of iron and steel goods had been desired it has not been notably successful, nor can it be said that the import tariff imposed by Canada has been of a character to stifle outside competition.

Production of Iron & Steel in Canada.

PRODUCTION of iron and steel in Canada is best measured by the annual output of ingots and steel castings. This, apart from an annual production that had not exceeded 30,000 tons, commenced with 200,000 tons from the Sydney Plant in 1902, reaching a pre-war peak in 1913 with 1,169,000 tons. In 1918, under the spur of war, steel ingots and castings to the extent of 1,873,000 tons were produced, falling in 1919 to 1,030,000 tons. It may be said, therefore, that but for the unusual and imperative demand occasioned by the war, the steel output of Canada has remained stationary for about eight years, or from 1912.

It is therefore fair to say that the import duties have not been too heavy, if judgment is based either on the volume of imports, or on the volume of domestic production. They have not been remarkably successful in stimulating the basic part of the iron and steel trade in Canada.

The General Iron & Steel Trade in Canada.

The statistics gathered by the Government in 1917 ascribe to iron and steel products the following extent and importance, namely :

Number of establishments	1,049
Capital	$307,407,980
Employees on Wages	70,071
Wages paid	$ 68,947,610
Cost of Materials	$204,732,121
Value of products	$400,385,086

The number of works in Canada making the basic products of iron and steel, (on which protection by tariff is given) does not exceed nine, if blast-furnaces are counted, and is not in excess of say one hundred, if electric furnaces, small open-hearth furnaces and similar equipment is considered. It is apparent from a study of the foregoing figures that the great bulk of the iron and steel industries of Canada exist by fabricating and making into manufactured articles the partially finished steel and iron goods that are imported into this country, to the extent of almost 200 million dollars worth annually.

It is most evident that the existing tariff has not operated to restrict the growth of the general iron and steel trade in Canada.

The Influx of United States Iron & Steel Trades into Canada in Recent Years.

ONE of the outstanding features of trade in Canada during the past few years has been the large and unremitting increase in the number of United States concerns engaged in the metal trades that have set up establishments in Canada. The lists of incorporations and the trade notices contain a preponderance of items of this nature. The extension of United States concerns into Canadian markets is rather more notable than the formation of new enterprises backed by Canadian men and money.

The cumulative evidence of the increase of imports of iron and steel, before mentioned, taken together with the notable increase in establishments of United State's origin within our borders, indicates that while the tariff has not hindered to any appreciable extent the imports of iron and steel into Canada from outside, it does make it desirable, from the viewpoint of United States interests, to come into Canada and set up establishments.

This we take it, was one of the objects of those who framed the tariff—so far as iron and steel is concerned—and it has been attained.

A Washington Opinion.

ALL of the foregoing gives point to the opinion of the Washington correspondent of "Iron Age" who may be taken as accurately representing the viewpoint of our not disinterested friends in the United States.

"Iron Age" in the issue of 26th August, states :

"Plans for the revision of the Canadian tariff laws " have a particular interest to the United States's iron " and steel industry. No other section of the Cana- " dian tariff statutes is so comprehensive as the one " which covers importation of iron and steel. More " than one hundred individual paragraphs are devoted " to this industry. The law, as it stands, was care- " fully written to protect Canadian industries. If " Canada produced the article in question, it was " pretty sure to put that article under a protective " tariff. If Canada did not, the duty was low, or was " removed entirely."

This is a fair statement from a representative quarter, and accurately portrays the viewpoint of the United States iron and steel producer, who, while not disinterested in the matter, yet looks to Canada for such a comparatively small portion of his business, that he can take an unbiased critical attitude regarding the tariff policies of this country.

The existing Canadian tariff was, as "Iron Age" states, very carefully prepared, and has not, as we have attempted to show, worked decidedly to the advantage of the Canadian producer, nor decidedly to the disadvantage of the United States importer. Much has happened, however, since the tariff was written, and new branches of the metal working industries have come into Canada, such as factories for automobile manufactures of various kinds, the manufacture of alloy steels and special tool steels, the manufacture of ship-plates, of black and tin-plate, steel shipbuilding on a large scale, and other important accretions to the industry. The tariff requires to be enlarged so as to foster these new industries, and it is very desirable that clear statements shall be presented to the Tariff Enquiry Board at its sessions.

The interests of Canadian iron and steel producers are diversified, and may conceivably clash, because of the extent of our country, and the relative nearness of certain portions of it to the United States, as opposed to the remoteness of certain other sections from any large centres of population or industrial activity.

So far as the eastern steel companies are concerned, they are most vitally interested in the preservation, and if possible, in the increase of the duties on import coal. In the present state of the coal market the existing duty on coal is entirely a negligible factor, if restriction of imports and encouragement of home production is desired. When coal costs $12 at the pitmouth, a protective duty of 56 cents is neither here nor there.

On the other hand, the steel trades in central Canada desire coal as cheaply as possible, and may not favor even the retention of present duties.

There are other points of apparent divergence in the interests of the iron and steel trades taken as a whole in the Dominion, but there are far more numerous points of common interest, and much need for common action in arranging that the position of the industry shall be presented to the Tariff Board fairly and accurately.

Shipbuilding in Canada

A consular report to Washington from U. S. Consul Felix Johnson, at Kingston, upon the state of Canadian steel-shipbuilding combines some truth with a good deal of misapprehension of observed conditions. The Washington despatch runs to the effect that Canadian shipbuilders are "urging a direct subsidy for every ton of shipping built in the Dominion as a means of saving the industry from ruin." "Canadian shipbuilding practically got its start from the encouragement given by the Government during the war", Mr. Johnson is stated to have reported. Much the same might be said of the recent progress of shipbuilding in the United States.

The Washington despatch called forth a rather quick correction from Ottawa, which concluded by saying that the Canadian yards are not facing ruin, "nor are they at present "pressing their request for a subsidy."

We believe it would be a more correct presentation of the situation to state that the war proved to the Canadian Government that it had pursued a wrong policy in withholding subsidies in assistance to steel shipbuilding before the war. The proper time for the Canadian Government to have encouraged steel shipbuilding was when legislation was passed confining coastwise shipping to vessels sailing under Canadian or British register. This legislation, to achieve its main object should have included definite plans to commence shipbuilding in Canada, but, as this was not done, its only effect was to increase the numbers of vessels under British register, thereby increasing the number under British control, without adding to the vessels owning Canadian registry. This had the effect during the war of decreasing the number of vessels under Canadian control.

The successful progress of steel shipbuilding in Canada, has in recent years been somewhat of a surprise even to the Canadian people that have undertaken it, but the industry has taken such a hold that whether the Government assists by a direct subsidy or not, the people of Canada will not willingly relinquish the status attained.

We venture to believe, however, that the industry will be carefully followed by Canadian governments, and that aid will be extended should it become necessary in the future.

In viewing this matter, as in so many other matters, it is necessary to divorce the viewpoint from consideration of Canada's present status. It is not necessary to suppose that because European shipyards could at one time construct vessels at so low a cost as to render competition from this side unavailing that this can ever be done again. Wages, costs, availability of materials, availability of workers, social conditions, forms of government and many other matters have undergone and promise still to undergo such changes in Europe that no one can prophesy what the future economic position is to be, nor how our position on this side will compare. In Canada we can look with certainty to growing population, increasing wealth and increasing industrial skill. The relative value of currencies has not yet assessed the industrial strength of the nations as it will do sooner or later, but in Canada we have those factors of youth, latent resources, unoccupied lands, and growing population unrestricted in its growth, that assure financial strength.

All that Canadian shipbuilders will ask of the Government will be assistance to bridge over a period of trial that is possibly awaiting shipbuilding, in common with other industries, but it is not correct to assume that Canadian shipyards must be operating at a loss, or that they are facing ruin. Some ephemeral concerns, designedly so, will pass away, but there are others in Canada that have the promise of permanence, particularly where, in lieu of attempting to compete with European yards, Canadian enterprises are linked up with long-established shipbuilding firms from over the water. And over all, we believe the Canadian Government will exert a fostering influence, it being the body most vitally interested.

Bounties on Canadian Iron Ore

THE Ontario Mining Association has expressed itself as favoring the bonusing of iron ore produced from Canadian deposits, having more particularly in view the ores of low iron-content that are found in the Michipicoten Ranges and the Canadian extension of the Lake Superior deposits.

There have been many resolutions passed by public bodies, and many suggestions made to the Government of Ontario that stimulus should be given to the production of iron ore in the Province, but, hitherto, there has been a division of opinion among those interested. Some owners of iron-ore areas have desired a bounty on the production of ore, while others, who are both mine operators and users of iron ore, have asked for a bonus on pig iron made from Ontario ores.

The opinion expressed by the Ontario Mining Association is therefore important, because this Association is in a position to speak definitely and with some authority for the mining industry and the allied steel industry of Ontario.

At the meeting of the Canadian Mining Institute, last March, the Ontario Minister of Mines expressed himself as definitely opposed to bonusing of iron-ore production in Ontario, but in doing so admitted that he did not know much about the subject, and was open to receive information. It was probably in view of this attitude of the Provincial Government, that the Ontario Mining Association appointed a competent committee to present the case for bonusing to the Government, and to offer the assistance of the expert knowledge of the Association in the formulation of the Government policy.

There is this to be said for iron-ore mining in Ontario (and it is equally true for all other Canadian provinces) that low-grade ores were never so valuable, and their utilisation was never so well understood as is the case today.

"Iron and Steel of Canada" has with some persistence drawn attention to the changing comparative value of iron ores, and the different regard in which lower grade ores are now held, because of the lessening availibility of Bessemer ores; and, whether or not the time is opportune for the more extensive use of beneficiated ores in Ontario or not, it is certain that we are measurably nearer that time, and at least so near as to justify the Government of Ontario in adopting a policy designed to assist iron-ore mining, such as has been adopted by British Columbia, and, in less generous measure, by Nova Scotia.

It is also desirable that the beneficiation of iron-ores by grinding, washing, roasting and magnetic concentration now being tried on a commercial scale in the Lake Superior District, and particularly at Duluth, should be followed closely by the technical officers of the Ontario Bureau of Mines, and that some consideration should be given to the initiation of experiments of similar character, on a smaller scale, on Canadian ores from the Lake Superior region.

It should not be forgotten that one of the most technically interesting, and also one of the commercially hopeful attempts to utilise Ontario ores by beneficiation preliminary to charging to the blast-furnace is being carried on by the Algoma Steel Corporation in mining and treating the siderite mined in the Magpie Mine in the Michipicoten District. But for this enterprise the mining of domestic iron ores in Canada would have disappeared from the records, and even the miserable five per cent of Canadian ore that is our present domestic contribution to blast furnace chargings in Canada, would not stand to the country's credit. The Algoma Steel Corporation deserves well of Ontario, and the unique character of its industrial contribution is not so well recognised as it should be.

This paper would express the opinion that a bounty on pig-iron smelted in Canadian furnaces from Ontario ores would be the most effective means of stimulating the mining of iron ore in Ontario. Such a bounty would involve no disbursal of government aid until a stage in the utilisation of ore that would have repaid the Province by the impetus given to industry, and the risks involved in qualifying for such a bonus would devolve altogether on those who attempted it. If it is objected that a bonus would unduly favor the one existing industry, we would suggest that it long ago qualified for government encouragement, and it is a poor reason to advance for refusing general encouragement to a necessary development of provincial trade that one courageous enterprise might be benefited, although we have heard this reason advanced.

Attention requires to be drawn in Canada to the distinction between two classes of industry, which may again be sub-divided into industries of primary and secondary national importance. There is first that class of industry that only requires moderate tariff protection to ensure its success. There is a second class that not only needs tariff protection, but a state subsidy, and, generally speaking these forms of assistance are not wisely extended unless the industry can be classed as of primary national importance.

The production of iron and steel, and of coal, are two basic industries that in Canada require not only tariff protection, but further assistance, because it has not been accounted wise for any nation to voluntarily depend on outside sources for these essential materials; and, on a strict basis of cost of production and excellence of product, the United States can easily dispose of any competition from Canadian sources in the Canadian market.

The bonusing of pig-iron made from Canadian ores should therefore be regarded not as a pure business matter, but as the price necessary to secure one independence in the matter of iron and steel supply—or at

least to minimise our present condition of dangerous dependence on an outside source.

Fuel supply is a matter of rather more importance today in metallurgical industries than ore supply, and the problem is more acute in Ontario than in any other province. In this regard it is interesting to note that the Ontario Mining Association suggests the feasibility of using Alberta coal. There is only one thing against Alberta coal, and that is the distance it must be transported to be used in Ontario. This also, we suggest, is a question that will have to be decided as affecting national security, and not altogether on a basis of commercial comparison between delivered costs of United States coal, and Alberta or Nova Scotia coal, at Ontario points.

As a matter of practical international policies it is probable that the steel industry in Ontario will continue to thrive by employing United States coal and ore, and such modicum of domestic ores as may be feasible, but, under such conditions it cannot be said that the steel industry is self-contained or that it would be in a position to operate in the event of the sources of supply in the United States being cut off. This possibility constitutes the most compelling argument for the encouragement of iron-ore production in Ontario.

MANUFACTURING IN WESTERN CANADA.

Elsewhere in this issue is an excerpt from the monthly Bulletin of the C. P. R. which deals interestingly with the expansion of manufacturing in the West. A single statement is sufficiently remarkable to attract wide attention, namely that since 1900 the value of the produce of western manufacturies has increased from 34 million dollars to over 400 million dollars, or by twelve times. Astonishing as this rapid growth may seem, it may be very confidently predicted that it is but small compared to that which the near future holds for the West.

The value of the manufactured articles of Canada to that of the value of field crops was in 1919, about as three is to one. Up to the present time the ratio between agriculture and manufactures has in the West been disproportionately in favor of agriculture, and has not conformed to the general average of the country. This has in large measure accounted for the traditional attitude of the west towards protective tariffs in aid of domestic industries. We venture to predict that the time is coming when the ratio of manufactures to agricultural production will be more pronounced in favor of manufactures in the West than in the case of the general Canadian average, for the reason that the West possesses the essentials for manufacturing on a scale that the East does not—and in particular it possesses an abundant supply of that indispensable and destiny-disposing material which is the basis of all manufactures—coal.

The possibility of the presence of oil in the Canadian West is one that properly excites much interest, and some justifiable hopes, but we would point out that in its coalfields the West has a more permanent supply of motor-spirit than can ever be looked for from the unknown sources that produce petroleum.

MANUFACTURING IN WESTERN CANADA.

The western provinces of Canada are generally considered as forming a purely agricultural area, and in the occurrences of new land settlement, increased cultivation and bumper yields, the progress of this region in industry and manufacture is often lost sight of. Nevertheless, the west is making phenomenal strides in manufacture and each week sees recorded the establishment of new industral concerns n the progressive towns of the western provinces.

Remarkable Extension.

An indication of the progress which the west holds in common with the rest of the Dominion is the remarkable enlistment of the last decade in the ranks of the Canadian Manufacturers' Association. The Dominion membership, which in 1910 numbered 2,600 now totals more than 4,100. In 1919 there were in the province of Manitoba 102 members; there are now 343. Alberta and Saskatchewan a decade ago had but 16 members between them; they now have 173. British Columbia's membership, n the ten years, has grown from 113 to 162. Whilst in the decade, the Dominion increase was 1,500 or approximately 58 per cent., the four western provinces combined have, in the same period, increased their membership by 447 or 190 per cent.

The rapid development that has taken place in Western Canada during the past two decades is well illustrated by the records of progress made n the various manufacturing industries, the value of whose products in 1900 was but $34,330,000, whereas in 1917 it was $405,557,000. The following is a comparative statement of capital invested, wages paid, and the value of products covering a perod of 17 years.

Capital Invested in Industries.

	1900	1910	1917
	$	$	$
Alberta	Not given	29,518,346	63,215,444
Saskatchewan .	1,689,870	7,019,951	33,114,630
Manitoba	7,539,691	47,941,540	101,145,033
British Columbia	22,901,892	123,027,521	221,436,100
	$32,131,453	$207,507,358	0418,911,207

Wages Paid.

	1900	1910	1917
	$	$	$
Alberta	465,763	4,365,661	10,387,379
Saskatchewan .	No figures	1,936,284	7,007,073
Manitoba	2,419,549	10,912,866	19,599,051
Brtish Columbia	5,456,538	17,204,670	38,269,366
	$8,341,850	$34,455,481	$75,262,869

Value of Production.

	1900	1910	1917
	$	$	$
Alberta	....	18,788,826	71,669,423
Saskatchewan . .	1,964,987	6,332,132	40,657,740
Manitoba	12,927,439	53,673,609	112,804.881
British Columbia	19,447,778	65,204,236	171,425,616
	$34,340,204	$143.998,803	$406,557,660

BOOK REVIEW.

THE IRON ORES OF LAKE SUPERIOR. Crowell and Murray, Chemists and Metallurgists, Cleveland, Ohio. Published by the Penton Press, Cleveland, 1920, 6 by 9 inches, Buckram Boards.

This standard reference work on the Lake Superior Iron Ores and all that appertains thereto is issued in a fourth revised addition. New chapters have been introduced, presenting the average analyses of all the iron ores of the Lake Superior district since 1902. The statistical part of the volume has been added to in order to bring all figures up to date of 1920 from the last edition of 1917.

An interesting chapter is that which describes the method pursued at the loading docks to ensure a uniform analysis of the ore contents of a given pocket. By the addition of one or more cars of ore of known content, known as the adjusting or balancing cars, to a partially filled pocket of ore, the average grade of which is also known, the average grade of the ore in each of the selected pockets is brought up to precisely the analysis specified.

A concisely summarised account of the progress of beneficiating the Superior iron ores is given in Chapter Six.

The following account of the Canadian extension of the Lake Superior deposits is accurate, and we could wish it were more promising. The possibilities of beneficiation, however, allow a more cheerful view to be taken of the future of iron-ore mining in the Lake Superior ranges in Canada than has hitherto been possible.

With regard to the Canadian deposits, the volume states:

"On the Canadian shore of Lake Superior, and in the adjacent territory, there are large areas of iron-bearing formation similar to those found on the American side, but as yet most of the exploration in these areas has been disappointing. The oldest productive range in Canada, and the largest shipper, is the Michipicoten Range, which is lies on the north-eastern shore of Lake Superior northeast from Michipicoten Island. This range was first opened up in 1897, as a gold mining district, but soon became far more valuable as an iron range. The Helen Mine has been a shipper from this range since 1900. The only other producing mine on the range, the Magpie Mine, made its first shipment in 1913. The Moose Mountain District is located about 30 miles north of Sudbury, Ontario. It was first opened up in 1902. The only mine at present on this range is the Moose Mountain Mine, which began shipping in 1908."

A STUDY IN CANADIAN IMMIGRATION. By W. G. Smith. The Ryerson Press, Publishers, Toronto. Linen Boards. 5 by 8 inches. 406 pages. Price, $3.00.

The preface of this book announces that it has many defects, but a perusal of the work reveals that its defects are not those of its author, but reside in the incomplete character of our vital statistics, and the difficulty of interpreting figures that are incomplete, and of too short a duration to enable critical elucidation and analysis. Not that the mass of statistical information in this work is meagre, for it contains sixty-one tables that must have cost the author tremendous labor to compile.

As an example, may be mentioned the attempt to trace the percentage of infirm and defective persons in Canada among the various contributory sources of our population. Statistics of this kind are useless unless they contain data as to the ages of the persons considered, and the large per centage of infirm persons shown by the statistics to be of native Canadian origin is doubtless due to the number of elderly persons included, whereas the immigrant population, at any given time, naturally contains persons that are, in the phrase of the insurance actuary of "effective age," and are, by natural selection, neither very young, nor very old.

The author is an optimist on the ability of Canada as a "melting-pot" of nationalities, but he points out with clearness the dangers of indifference towards the strangers in our midst, and the undesirability of allowing foci of extra-national culture to multiply in our midst. He says, with fine fervor, and much truth, "What is needed is a new crusade of young Canadians "in whom the fires of patriotism burn, who will man "the outposts of Canadian nationality." He points out the hardships suffered by the immigrant, who he describes as the "lineal descendant of the forgotten pioneer, and like the pioneer achieves competence and prosperity." The problem of the immigrant is the problem of the Canadian people, who through their Government have advertised abroad and solicited the emigrant at home. The author points out how many millions of money have been spent in solicitation of emigrants, and how little in comparison has been spent to retain and incorporate the immigrant into our national fabric when arrived.

We have always considered that the work of the "Reading Camp Association," now known as the Frontier College, one much needed in Canada, and those who have read "A Handbook for New Canadians," by Mr. Alfred Fitzpatrick, will find in it the answer to many of the questions raised by Mr. Smith's book. As Mr. Fitzpatrick pointed out, and as Mr. Smith intimates also, the newly arrived immigrant in Canada is the prey of his environment and too often of his own countrymen, who because of their knowledge of the immigrant's language are too complaisantly allowed to control their compatriot's housing, supplies and general destiny in Canada. Tutelage in Canadian institutions, in the English language, and in citizenship is required to assimilate the immigrant, and Mr. Smith says truly: "A thousand new teachers in as many teacherages would mean the beginning of a new day."

"In time of war a half million of our best were enlisted in a gigantic struggle of destruction. In times of peace can there not be a brigade or two of equally ardent spirits who will engage in the work of construction?" The Frontier College would seem an organization ready to hand for a work that recent events have revealed as desperately necessary.

Mr. Smith advocates restriction of immigration in lean times, and stricter supervision of incomers in good times. He asks for inspection of emigrants at the point of departure, and suggests the throwing of greater selective responsibility upon the steamship and other agencies that earn dividends by bringing emigrants to Canada. He pleads for a large and adequately equipped institutions like Ellis Island at several points of main entrance into Canada, and asks that regulation of immigration shall be planned with a view to the tremendous scale on which it may be expected in years yet to come. Due credit is given

to improvements in the Immigration Law, but it is suggested that immigration may be expected to be larger in coming years.

Mr. Smith has presented a lot of problems that he has not attempted to answer, but his book contains many statistics in understandable and convenient form which may lead enquirers to a better grasp, if not a solution, of the individual problem they themselves are faced with in connection with immigration.

We commend the work to officials of Canadian corporations who desire the foreign workman, to employment and welfare officers.

After perusal of the volume we would summarize the desirable conditions in connection with immigration to include the following. Careful selection of the country in which emigrants are to be solicited. Some countries—Finland for example—seem to yield undesirable elements in large proportion. Agreement with the government of the emigrant's country on the lines laid down by the Italian government and designed to protect against exploitation of the emigrant by his own compatriots both during his journey to Canada, and after his arrival there. Examination of intending emigrants at or previous to embarkation for Canada. Enlarged and centralized examination and detention facilities at the point of debarkation in Canada. Continued interest in the immigrant in his sojourn in Canada, and a deliberate and widespread campaign for his Canadianization, including discouragement of all forms of national segregation and the formation of communities in Canada detached from Canadian influences. Unless we Canadianize our immigrants then we risk the un-Canadianizing of Canada.

THE MINES HANDBOOK. The Mines Handbook and Copper Handbook for 1920, Vol. XIV, 6 by 8½ by 2½ inches. 1992 pages. Cloth Boards. Price $15.00. Published and compiled by Walter Harvey Weed, New York City.

The latest edition of this standard compilation covers the mining industry of the world for 1918, 1919 and the first quarter of 1920. It is announced that the Handbook will hereafter be published annually, delay in issuing the 1920 volume having been caused by labor troubles and paper shortage.

The Handbook contains statistical information regarding the production, consumption and United States exports and imports in all commercial metals. The scope of the work is comprehensive, covering as it does the metal mining industry of the world, and the information, so far as we are in a position to check it from the references to Canadian and Newfoundland mining operations, is complete and accurate.

This Handbook is a necessity in the library of consulting mining engineers, metal brokers, dealers in mining equipment and supplies, and all who are interested in mining, more particularly in America.

STEEL COMPANY OF CANADA TO BUILD A WIRE-FENCE PLANT.

It is understood the Steel Company of Canada purpose to erect a plant for the manufacture of wire fencing at Hamilton. Approximately $250,000 is estimated as the cost of the necessary initial expenditure.

ONTARIO MINING ASSOCIATION FAVORS BOUNTY ON IRON-ORE MINING IN CANADA.

A semi-official statement which has appeared in the newspapers announces that an active effort is about to be made by the Ontario Mining Association to secure the payment of a bounty on iron ore produced in Canada by the Dominion and Provincial Governments. With this object in view a committee, consisting of Col. J. W. Leonard, of St. Catharines, A. J. Young of Toronto and George Cowie, of the Algoma Steel Corporation, Sault Ste. Marie, has been appointed to investigate the question fully and to co-operate with any other committees that may be appointed with the same object in view. While it is too soon as yet for the committee mentioned to have decided upon any line of policy, it is understood that the bounty being asked by the iron ore producers is 75 cents per long ton of 2,240 pounds mined and beneficiated in Canada in the next fifteen years. It may be that the Ontario Mining Association — though this is not by any means certain — will concur in the stand taken by the iron producers, but this is for the future to determine. At the moment all that the Association has done is to make a declaration in favor of the principle of a bounty, leaving the details to be worked out before the next meetings of the Federal Parliament and the Provincial Legislatures. It has been suggested that 50 cents a ton should be secured from the Dominion Government and the additional 25 cents from the Provincial Legislature that may be interested.

The amount of iron ore produced in Canada in 1909 amounted to 268,043 short tons and attained its highest point in 1915 when 398,112 tons were produced, the total declining in 1918 to 206,820 tons. The amount of iron ore furnaced in Canada reached a total of 231,994 tons in 1909 and had dropped to 96,745 tons in 1918. While the amount of iron ore produced and treated in Canada has thus shown a marked diminution in the last decade, the amount of the imports has been materially increased; the total imported in 1909 was 1,235,000 tons against 2,145,592 tons in 1918.

The total consumption of iron ore in Canada was 2,242,337 tons in 1918 and the amount imported from the United States and Canada as has been seen, was 2,145,592 tons, showing that all but 96,745 tons, or only 5 per cent of the total treated, was brought into the country from outside points. That 95 per cent of the iron ore treated in Canada has to be imported has a material effect upon the balance of trade—one that the Dominion should have rectified as speedily as possible. It is felt by the officials of the Ontario Mining Association that the payment of a bounty on iron ore produced in Canada would go a long way toward remedying this abuse. Especially is this the case when it is known that no country has become a great producer of iron without first having secured Government assistance. Only one iron mine so far developed in Canada has produced ore in very considerable quantities; this was the Helen mine in the Michipicoton district, but it became exhausted a couple of years ago.

Aside from the products of the farm the wealth of a country is mainly derived from its coal and iron deposits. Over 50 per cent of all the tonnage originating in the United States is composed of iron or coal. A similar situation might well be developed in Canada. Were that the case it readily can be seen how, with a judicious encouragement of the iron industry, what is now practically a barren area between Sudbury and

Port Arthur could be made to yield an enormous railway tonnage. Electric smelting has been made a success in Norway and it is approximating a success in Canada. In the area described there is no end of water power for the operation of electric plants while fuel is very difficult to secure. There are consequently at hand all the elements of a prosperous industry; all that is required is the necessary encouragement to capitalists, as in other countries, to risk their funds in an undertaking that is almost certain to lead to an adequate reward.

PUTTING CANADIAN IRON ORE ON THE MAP

By J. J. O'CONNOR.

If Canada is to keep pace with her competitors for world trade, if her great fleet of merchant ships are to be kept employed in carrying our own products to world markets, if she is to pay her debts out of her own resources, she must develop her enormous deposits of iron ore, in order to occupy that industrial independence that will enable her to compete successfully for the foreign trade that is so vitally necessary to her future.

A glance at the past shows that all that is needed to make Canada a leader in mineral production, is well directed, and sustained effort on the part of Government and people, in the exploitation of her vast store of mineral wealth. In 1886 Canada's mineral production amounted to $2.23 per capita, in 1917 it had reached $23.12 per capita. If iron ore production had made the same advance as all other minerals, if imported iron ore had been displaced by domestic ores, and if the enormous importations of iron and steel products—now in the neighbourhood of $175,000,000 annually—had been displaced to a great extent, by our own manufactured articles, as they very well might have been, our mineral production would show a vastly increased sum per capita.

That this industrial independence may be brought about, is but reasonable to suppose, in the light of what is being done in other iron fields, by our neighbours in Minnesota, where millions of tons of iron ore are being beneficiated annually, and millions of dollars are being expended in the installation of plants for the magnetic separation and concentration of low grade iron ores, similar to our own.

The province of Ontario is wholly dependent on United States ores, with the exception of the extremely small percentage of domestic ores now being charged to the furnaces of this province.

The Ontario Government is directly interested in the industrial decevelopment of its own estate. The Federal Government is equally interested in the upbuilding of an iron and steel industry in Canada, adequate to its needs, therefore, they should co-operate in demonstrating the commercial feasibility of converting our low grade ores into a desirable product for furnace use.

The Bureau of Mines, Toronto, and the Mines Branch, Ottawa, should make a joint, and thorough investigation of what the Mesabi Iron Co. have done in their experimental plant, at Duluth, and what they are now doing at Babbitt, Minn., as a result of the experiments carried on at Duluth, where they produced thousands of tons of ore that met the highest furnace requirements.

Skillings' Mining Review, an outstanding authority on Minnesota iron ore, in a recent issue, says, in part: "The work of pouring concrete for the foundations for the first mill unit of the ore treating plant of the Mesabi Iron Company, at Babbitt, Minn., will be begun early next week, and the work of erecting the steel for the superstructure will be begun about August 15th. Four hundred men are employed by the company at Babbitt, and the immediate vicinity, in the extensive preparations necessary to whip this new and important iron mining enterprise into shape for production. The company will enter the shipping list with its product at the opening of navigation next spring. This initial unit has an estimated capacity for treating 3,000 tons of ore per day, but it will occasion no surprise if the over-run is considerable. The size of the new mill will be total length 1350 feet, and width 130 feet. The plant consists of five sections laid out to give continuous process. But to return to the mill that is being erected out there in the wilderness of the Eastern Mesabi. The Minneapolis Steel Machinery Co. has the contract for the steel. While people are vastly interested in the fact that the Mesabi Iron Company is spending about three million dollars on the Eastern Mesabi, the real basis of this interest lies in the fact, that the expenditure is being made to establish on a broad commercial basis, an advanced principle in magnetic separation. Magnetic separation is the principle on which this costly development is being founded, and this company has produced separators that are expected to do their work more efficiently than any heretofore built. The modus operandi is as follows: Mine, crush, grind to powder and separate the ore from the rock, and form the concentrate into clinker by the sintering process, for blast furnace use. The final clinker will be a very high grade iron ore, free from moisture, free from all deleterious elements, such as sulphur or titanium, and dust. There are billions of tons of low grade magnetic ore, or taconite, on the Eastern Mesabi. The Mesabi Iron Company alone controls, or owns outright, many hundreds of millions of tons itself, in the 20 square miles it has taken over. It would seem that the Mesabi Iron Company had fully worked out its problems in metallurgy, when one considers the success of the first cargo of the product of the low grade magnetic ores, which was produced in the experimental plant at Duluth. As far as can be seen, all problems of the future were met in the production of the first cargo. Assuming that to be the case, the company seems destined to become one of the chief factors in the future of the iron ore industry of Lake Superior. It has brought into being an enormous mass of iron bearing material that gives every promise of lengthening for a very great many years, the life of the iron, mining industry of Minnesota."

With this experience before us, and the success it has met with, it would seem idle to not take advantage of the opportunity of investigating this great enterprise, and determining its adaptability to our own ores. Both Governments have the necessary machinery at hand, for making such an investigation. Added to this, is the highly satisfactory results in magnetic separation, obtained by Prof. Stansfield, of McGill University, recently. It is to be hoped that this matter may not be longer deferred, and that immediate action may be taken. The Tarriff Commission would do well to look into the question of the vast tonnage of iron ore, and iron and steel products imported annually, and its effect on the commerce of the country.

COMPANY NOTES

CANADIAN CAR & FOUNDRY COMPANY.

The Canadian Car & Foundry Company is stated to have nearly $40,000,000 in unfilled orders on its books, requiring a large amount of working capital. Because of this principally the Board of Directors is understood to have deferred action on payment of the 22¾ per cent. of preferred stock dividend arrears. This action of the Board, which is in the interests of enlarged future profits, is not understood to indicate any change in the intention to liquidate the preferred stock arrears at an early date.

BALDWIN'S LIMITED, TORONTO.

During August the Ashbridges Plant, Toronto, was visited by Col. Sir Charles Wright, a director of the British parent company, and during the war Director of iron and steel production in Britain. As such he was familiar with the work of the British Forgings Plant, which was acquired by Baldwin's Limited.

Sir Charles stated it was his Company's intention to make the Toronto enterprise one of the basic industries in Canada, and it was his expectation that in due course the plant would be able to supply the entire Canadian market for steel sheet, black plate, and black plate for tinning. The Company purpose to erect 40 mills at an outlay of about three million dollars, but owing to shortage of hydro-power the plant will have to be curtailed to suit. This has reduced the present possible extent of the installation to eight mills. When the Chippawa-Queenstown development is completed and the full requirement of 20,000 horse-power is available, Sir Charles said the plant would be enlarged to the size originally planned. He expressed himself as pleased with the progress of the work of erection, and the situation of the works.

Negotiations between the town of Collingwood and Baldwin Canadian Steel Corporation in connection with the latter's purchase of the Kennedy steel plant at Collingwood are still in progress. The town wishes to prevent removal of the bar mill and open hearth furnaces to Toronto, where the company proposes to use them in connection with the Ashbridges Bay plant. After deciding to fit up the British Forgings plant for the manufacture of tin plate, black and galvanized sheets, it was found difficult to get deliveries of equipment, so purchase of the Kennedy plant was made. The town claims that tax arrears amounting to $65,000 are due, and should be paid by the company.

There are at present ten electric furnaces at the Ashbridges Plant, but these are insufficient, and it is understood two 50-ton open-hearth furnaces are to be added, and also the two 35-ton furnaces which are being removed from Collingwood, the capacity of which will be enlarged.

It is understood the Plant will be ready to commence the rolling of tin-plate during September. Some 800 to 900 workmen will be required, which will include a number of skilled employees from the Company's works in Wales. The ultimate extent of the works may require the employment of over 5,000 workmen.

EASTERN CAR COMPANY, NEW GLASGOW.

This yard, a subsidiary of the Nova Scotia Steel & Coal Company, is actively employed on railway orders. For some weeks work was hindered by inability to obtain delivery of the steel necssary, but it is understood this difficulty has been overcome. There is reason to anticipate much general work for this yard in connection with the several railways of the companies associated in the British Empire Steel merger, all of whom will require much additional rolling-stock for railway operations, in addition to mine cars, skips, and underground haulage equipment for the iron-ore and coal mines, and the limestone quarries. The railways which will be operated by the merged companies include the Sydney & Louisburg Railway, the Cumberland Railway, running between Parrsboro' and Springhill Mines and the C. N. R. Junction, and the extensive colliery branches and assembly yards of the Dominion Iron & Steel Company, which in the aggregate will total not less than 150 miles of track. The Eastern Car Company is equipped to turn out a variety of railway and industrial cars, both of timber and steel, and of mixed construction.

The Dominion Government vs. Dominion Iron & Steel Co. in the Exchequer Court. Question of Remuneration for Rail Rolling ordered under War Measures Act.

A suit involving several million dollars, the point at issue being the value of steel rails which the Dominion Government, under the authority of the War Measures Act. compelled the Dominion Iron and Steel Company to roll during the war period for the use of Canadian railways, will be heard by the Exchequer Court at a sitting which opens on September 7. The amount involved is $8,727,617, less cash already advanced to the extent of $5,500,000. This make the actual amount in dispute upwards of three and one-quarter millions, with interest.

The amount of rails rolled under the Government's order was something in excess of 100,000 tons for which the company seeks payment at the rate of $75 per ton. As the Government considered the price too high provision was made by order-in-council for a reference of the dispute to the Exchequer Court.

The rails were delivered under the Government order to the Grand Trunk, Canadian Pacific and other roads, These railways have been made parties to the proceedings before the Exchequer Court, the purpose being to have the court declare that the railways must pay for the rails received the amount the court finds to be fair and reasonable.

Canadian General Electric Report Gain in Seven Months Orders of 1920 as Eight Million Dollars

The president of the Canadian General Electric Company recently announced a gratifying augmentation of the business of the Company. Mr. Nichols said his Company was not looking for new markets "for the reason that the domestic demand at present is ample to keep all our facilities well employed, notwithstanding the numerous extensions to our plant and equipment, which have been recently completed, or are now in process of completion.

As a matter of fact, our orders received for the first seven months of this year exceed in value those of the corresponding seven months of the previous year by upwards of eight million dollars, and I can foresee no reason why the demand should not continue, and for this reason the company have adopted a forward policy of providing for very largely increased manufacturing output.

It should be remembered that Canada is a country of great water powers, many of which are being utilized to only a small extent, so that the demand for electrical apparatus must continue in volume for many years to come irrespective of the demand in the near future for equipment for the electrification of sections of our trunk line railways."

International Nickel Company does not contemplate erection Rolling Mills in Ontario owing to Fuel Difficulties

Mr. J. L. Agnew, Vice President of the International Nickel Company, has denied the report given currency in Toronto that a $3,000,000 rolling plant would be established by the Company at Sudbury, Copper Cliff or Port Colborne. This project has been mooted for some time owing to the inconvenience which the company has sustained from having to send the metal to customs mills at Bayonne, N. J. to undergo the rolling process, but it is considered that the construction of such a plant in Canada, especially in the Sudbury district, at the present time would be impracticable. Mr. Agnew stated that if such a rolling plant were built, it would have to be so situated that the securing of pure oil, free from sulphur, at first hand, would be an easy matter. No conclusion has been reached as yet as to the location of a mill when it is decided to build one, but it is stated to be practically certain that it will not be built at Sudbury or Copper Cliff.

MONTREAL AND QUEBEC.

The National Farming Machinery Co., Montmagny, Que., has been preparing plans to manufacture all lines of farming implements and machinery and to increase its capacity has been making extensive improvements and additions to its plant. One of the features is the erection of a commercial rolling mill for the production of various grades of material used in the manufacture of farm machinery, which is expected to be in operation by next year, and will be equipped with 20-in., 12-in. and 8-in. mills. The company is fabricating all the structural steel for the new buildings and also constructing the units that will be used in the mill. The plant will be operated from power developed several miles up the river where a dam and power plant will be erected. Plans have also been prepared for the erection of a stove plate foundry and a malleable iron foundry, but it is not expected that construction on these plants will be started until next year.

Walter S. Walker of the Vulcan Motor & Engineering Company, a well-known English automobile company, recently visited Montreal and stated that the Vulcan Company, of which he is General Manager, contemplated the commencement of a branch of the enterprise in Canada. He is making a tour of the Dominion with a view to deciding upon location.

The Gurney Foundry Company, Limited, have purchased as a going concern the plant and equipment of the Canada Stove & Foundry Company in St. Laurent. The growing business of the Gurney Company in Toronto has for some time taxed the capacity of the Toronto Works and made it necessary to consider expansion. The Montreal plant purchased has made a specialty of enamelling stoves, and other enamel products, such as signs.

ONTARIO.

Hamilton : The Dominion Steel Foundry is building an addition to cost $30,000.

Universal Products Company, Limited, has been incorporated by Albert Mearns, Gerald M. Malone and others, all of Toronto, with capital stock of $3,000,000 to manufacture machinery, tools, etc.

Collingwood: The Imperial Steel & Wire Company is to erect a plant costing $150,000.

Brantford: The Cockshutt Plow Company is extending its operations, and will immediately build a blacksmith shop to cost $45,000.

TORONTO INCORPORATIONS.

The Canadian Edison Appliance Co., Ltd., has been incorporated with a capital stock of $1,000,000 by William A. J. Case, 94 Leuty Avenue; James B. Taylor, 801 Dominion Bank Building; George E. Atwood and others to manufacture electric specialties, machinery, tools, etc.

The Gem Safety Razor Corporation, Ltd., has been incorporated with a capital stock of $50,000 by Arthur A. Tritsch, 171 A. Keele Street; William H. Wallbridge, 19 Melinda Street; William H. J. Tubb and others, to manufacture safety razors, cutlery, etc.

The Page-Hersey Tubes, Ltd., has been incorporated with a capital stock of $4,300,000 by Leo W. Goetz, Donald P. Guthries, John Sutherland and others, all of Guelph, Ont., to manufacture tubes, machinery, implements, etc.

The Anglo-American Motors, Ltd., has been incorporated with a capital stock of $10,000,000 by John P. Ebbs, Duncan R. Kennedy, Edward R. Jackson and others, all of Ottawa, Ont., to manufacture automobiles, aeroplanes, motors, engines, etc.

The Superheater Co., Ltd., has been incorporated with a capital stock of $1,000,000 by Archibald W. Langmuir, 801 Dominion Bank Building; George M. Huycke, 143 Bloor Street West; Morely Smith and others to manufacture castings, implements, locomotives, boilers, etc.

R. Howie, Ltd., has been incorporated with a capital stock of $50,000 by Frederic B. Edmunds, 2922 Dundas Street West; Robert Howie, Alfred S. C. Oakley and others, to manufacture trucks, motors, accessories, etc.

Finch & Anderson, Ltd., has been incorporated with a capital stock of $200,000 by Frederick G. Finch, 60 Wilson Avenue; Delbert L. Constable, 24 King Street West; Frank G. Anderson and others to manufacture automobiles, motors, engines, etc.

The Cornfield Wheel Co., Ltd., has been incorporated with a capital stock of $750,000 by George M. Huycke, 801 Dominion Bank Building; Norman E. Strickland, 5 Dundonald Avenue; Thomas Delany and others to manufacture motor and truck wheels, tools, parts, etc.

The Toronto Computing Scale Co., Ltd., has been incorporated with a capital stock of $200,000 by James Parker, 157 Bay Street; Maurice Crabtree, 575 Ossington Avenue; Mortimer S. Hooper and others to manufacture scales, weights, measuring machinery, tools etc.

The Instantaneous Electric Heater of Canada, Ltd., has been incorporated with a capital srock of $250,000 by James E. Day, Joseph P. Walsh, Frederick R. Marshall and others to manufacture electric stoves, heaters, machinery, motors, etc.

To carry on the business of iron-masters, steelmakers, etc., miners and smelters the American de Levaud Manufacturing Company, Limited, has been

granted Dominion incorporation with a capital stock of $7,500,000. The incorporators, all of Toronto, are: J. H. Phippen, V. E. De La Haye, H. J. Dawson, J. H. Neelon, and F. A. Blackburn. The chief place of business is given as Toronto.

A. M. TIRBUTT EXTENDS DUTIES

A. M. Tirbutt, vice-president and general manager of the Manitoba Steel Foundries Ltd., has also been appointed vice-president and general manager of the Taylor and Arnold Engineering Company, Ltd., which will necessitate him dividing his time between Winnipeg and Montreal, but as the headquarters and plant of the Taylor and Arnold Engineering Co., Ltd., are situated in the east, it is understood that he will make his headquarters in Montreal. Both these concerns are under the presidency of Thomas Arnold.

A. G. BROWN & A. L. BROWN FORM PARTNERSHIP

A. Gibson Brown and A. Leys Brown have formed a partnership under the name of A. G. & A. L. Brown & Co., with offices at 207 St. James St., Montreal to act as Canadian Agents for British and American hardware manufacturers. They have both been Overseas and prior to the war Mr. A. G. Brown was with the wholesale hardware house of Frothingham & Workman Ltd., and also travelled for some time for the Peck Rolling Mills Ltd.

MANITOBA ROLLING MILLS INSTALL OPEN-HEARTH FURNACE

Will Use Pulverised Coal.

The Manitoba Rolling Mills recently installed a new open-hearth furnace in its works at Selkirk, and a party of Winnipeg men were invited to see the furnace in operation for the first time. The furnace is heated by pulverised coal. Mr. Deacon, the President of the Manitoba Rolling Mills, showed the party over the plant, and expressed the opinion that the installation of this modern open-hearth furnace marked an epoch in steel manufacture in the West. In using pulverized coal, the Manitoba Rolling Mills are following a method that is now becoming very general, and the quality of western coals is such as to advise their use in pulverized form, not only in metallurgical operations, but in a good many other instances in industrial activities.

T. J. BROWN LEAVES NOVA SCOTIA STEEL & COAL CO.

Mr. T. J. Brown, except for a short interval in 1918, for many years general superintendent of the Sydney Mines operations of the Nova Scotia Steel & Coal Company, has resigned that position to become general manager of the Inverness Collieries, Ltd., a reorganization of the Mackenzie Mann enterprise in Inverness County, Cape Breton.

The Dominion Plate Mill.

The mill is working to capacity, and has rolled up to 350 tons in one shift. Plates up to 1½ inches thick are being rolled to European orders.

HIRAM WALKER & SONS, WALKERVILLE, ONT.

Manufacturers of Special Instruments, Furnaces and Nickel Alloys in Canada.

Hiram Walker & Sons Metal Products, Limited, Walkerville, are developing one of the most highly specialized Canadian industries. This company was first organized in 1909 under the name of Canadian Hoskins Limited, to manufacture in Canada the lines covered by the Marsh patent, covering Nickel Chromium Resistance Wire, Nickel Chromium Pyrometer Couples, Electric Furnaces using nickel chromium units, and Carbon Resistor Electric Furnaces, such as are commonly known as the Hoskins Furnaces.

Until 1914 the operation of the company were intermittent, but on January 1st, 1914, under the name of Canadian Hoskins Limited, the manufacture of a full line of furnaces in Canada was begun. In 1916 the manufacture of Nickel Chromium Resistance Wire under the Marsh patent and the trade name "Chromel" was started, and today this company supplies the largest manufacturers of electric devices in Canada, and a number in England with electrical resistance wires.

In furnace manufacture of Hoskins type, all sizes in laboratory furnaces are made and two muffle and crucible shapes for temperatures varying from 500 deg. to 3600 deg. F. Besides these, electric tools, annealing furnaces, oil tempering furnaces and electric furnace equipment for tool rooms are produced.

In 1918 Nickel Chromium heat resisting castings were added, and this company now supplies these to the United States in the form of carbonizing and annealing boxes. This alloy is known by the trade name "Nichroloy".

In 1919 a Nickel Copper Non-Corrosive Alloy was produced from which castings are supplied oil trades, chemical plants, power houses, or in general, places where metal having a high resistance to corrosion from super-heated steam or dilute acids is required.

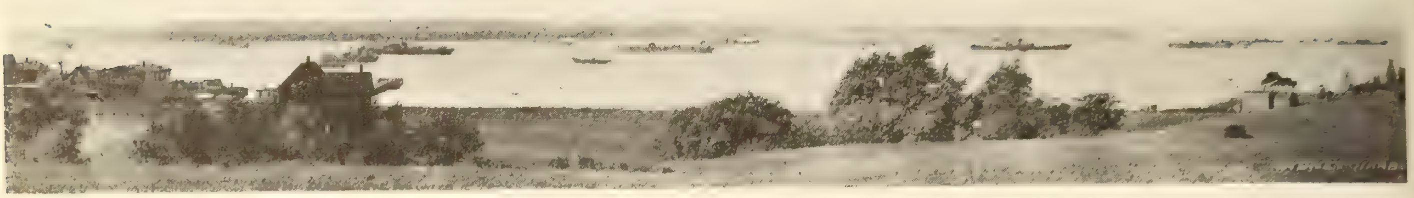
The production of Nickel Chromium Wire has been developed at this plant. A special process is being operated for drawing this wire.

Each year sees the results of progressive work, and just recently this company has produced a new resistance alloy for moulding zinc and lead. At present the alloy foundry has one alloy furnace for making various nickel alloys and complete foundry equipment for handling metals. A complete laboratory is maintained and a group of experimental electric furnaces for general testing of pressed alloys and for research work. Nickroloy Synthetic Monel Metal and their latest alloy was developed in one of their own Hoskins type A.B. 105 Electric Furnaces. It has a maximum temperature operating condition of 3600 deg. F. and a capacity of 25 lbs.

These developments based on Canadian resources show that in the most specialized metallurgical fields it is possible for a company to expand and compete in research, and do a world wide business from within the Dominion.—Canadian "Chemical Journal."

DOMINION BRIDGE TO REBUILD NEW GLASGOW PLANT.

Dominion Bridge is planning to rebuild its New Glasgow plant, which was destroyed by fire on July 7th. It is proposed to build a larger shop. Temporary operation has been possible through local arrangements the company was able to make.



SHIPBUILDING

Prince Rupert, B. C.

Announcement is made by W. P. Hinton, of the Grand Trunk Pacific, today, that the Prince Rupert Dry Dock tnd Engineering Company has close a contract for five steel tank steamers, to be built at Prince Rupert, with further offers pending for a large amount of miscellaneous tonnage sufficient to keep the large shipbuilding plant running for two or three years. Arrangements are being made to accommodate a staff of from 2,500 to 3,000 men.

Vancouver, B. C.

It is announced that the Canadian Pacific Railway has awarded a contract to the Wallace Shipyards of North Vancouver for a vessel to replace the "Princess Sophia" lost under tragic circumstances. Particulars of the vessel have not been given out.

Officials of the Wallace Shipyards announce that the first 8,300-ton launching from the North Shore yards will take place towards the end of August when the Canadian Government merchant marine steamer "Canadian Highlander" will be sent into the water.

The "Canadian Highlander" is a standard government steel freighter of 8,350 tons deadweight, oil burning , and similar in type to the Government steamers constructed by the Coughlan yards and by Victoria and Prince Rupert yards. The Wallace Company is building a sister ship, the Canadian Skirmisher, which is due to be launched early in November.

Victoria, B. C.

The Harbor Marine Yard expects to launch the "Canadian Traveller" about the middle of September.

Record of Victoria B. C. Shipbuilding Yard in Employing ex-service Men

The Harbor Marine Plant at Victoria, Vancouver Island has achieved a creditable record in the employment of ex-service workmen. Out of 1,348 men employed in the last 18 months, 1,137 have been returned soldiers, mostly unskilled workers, so far as shipbuilding is concerned. Labor questions have been satisfactorily adjusted by the Harbor Marine Veterans' Association, composed of ex-service workers on the plant, and there have been no labor troubles. It is unfortunate that the work of the Yard is drawing to a close, owing to completion of contracts, but during the period in which it has been in existence this enterprise has proved a notable help to the reestablishment of the large number of unemployed returned soldiers that were demobilized in British Columbia after the close of the war.

Port Arthur.

There was recently launched and completed at the yards of the Port Arthur Shipbuilding Company, Limited, Port Arthur, the Canadian Merchant Marine owned ship "Canadian Runner." This ship has an overall length of 335 ft., beam 44 ft., depth, 25ft., Triple Exp. Eng. 23-38-63-inch, Two Scotch Boilers, Dia, 15 ft. x 11 ft., Steam Pressure 180 lbs., Speed loaded 11 knots.

This vessel, which was built under the requirements of the highest Class of British Corporation for the Survey & Registration of Shipping, is of all steel construction, and carries a complement of forty of a crew.

This ship is intended for service on the Seven Seas, and has passed through the unique experience of being fully completed by the builders at Port Arthur, taking a cargo of grain to Port Colborne, proceeding to Ashtabula, Ohio, and being placed on the Dry Dock of The Great Lakes Engineering Company, and cut in two. Previous to cutting the vessel in two, watertight bulkheads were constructed forward and aft of the cut, which was made just forward of the midship houses, which contain the power plant and crew's quarters, neither of which were disturbed by the cutting.

After trimming both sections, which was done with water in the tanks, and some coal, the sections were ready for the last leg of the journey to Montreal, and were taken in tow by two tugs on each section. These tugs guided and towed the helpless sections across Lake Erie, through the Welland Canal, down Lake Ontario and the St. Lawrence River to Montreal, a journey of, approximately, 500 miles. Both sections arrived at their destination in good order on Sept. 1st.

The sections will be placed in Dry Dock, and joined together, when the ship will be formally turned over to the Government.

The Port Arthur Shipbuilding Company have completed a sister ship to the "Canadian Runner", which is alike in all respects.

This ship, the "Canadian Carrier", is also owned by the Canadian Merchant Marine, and left Port Arthur on Sept. 4th with a cargo of grain for a Lake Erie port. After discharging, the ship will proceed to Ashtabula, O., and be cut in two sections, and taken to Montreal in the same manner as the "Canadian Runner", for delivery to the Government.

The Port Arthur Shipbuilding Company have another ship on the stocks for the Canadian Merchant Marine. This ship is of Welland Canal size, and has a d.w. carrying capacity of 3,700 tons. This latter ship will be delivered before the close of the present season of Lake navigation.—J. J. O'C.

Toronto, Ont.

The Equitable Trust Company were refused permission at Osgoode Hall, Toronto, to enter an action against the Dominion Shipbuilding and Repair Company, now in liquidation, to recover $15,893, but granted the applicant a preferred claim in the winding up. The Equitable Trust Company issued letters of credit to the Dominion Shipbuilding Company and Christoffer Hanneveg, Inc. upon which large sums were advanced to the United States Steel Products Company for plates. The amount claimed is the balance due by the Dominion Shipbuilding Company on the advances. The applicants also claim unused material bought with the money, but His Lordship directed the liquidator to keep a record of the material used in completion of ships now under construction.

Dominion Shipbuilding Company's Failure Attributed to Closed Shop and Onerous Labor Demands

The immediate cause of the assignment of the Dominion Shipbuilding Company of Toronto is stated by the Assignee to have been insufficient quick assets to pay the current wage bill of $106,000. There main factors are said to have caused the financial collapse of the enterprise, namely, insufficient working capital, uneconomic conditions of labor and management, and inability to collect amounts due. The Assignee, Mr. Osler Wade of Toronto, submitted the following statement:

"The capital invested in this business was $1,000,000 as compared with $1,600,000 invested in fixed assets for the plant, etc., making it necessary to rely upon loans and advance payments on contracts to conduct operations.

"The labor and material costs (per ton) on hulls laid down to July 31, 1920, were: 1918, labor $40. material $76. 1919, labor $49, material $116; 1920, labor $61, material $95,and on the last hull in 1920, labor $73 per ton and material $94 per ton.

"The net result is—the last hull was laid down at a loss of $300, to which must be added penalties of $72,000. The arrangements with labor at the same time of closing down was for a five-day week of 44 hours, with double pay for Saturdays and over-time."

The assignee pointed out that the closed shop had had a serious effect on the labor costs in connection with the company's shipbuilding and declared that if shipbuilding was to succeed in Canada, the capital outlay in construction must be on a comparative basis with capital outlay on construction in any other market or, failing this, a Government subsidy to equalize the difference.

The financial statement submitted by the assignee showed assets totalling $2,691,476; liabilities, $1,134,212; apparent surplus, $1,557,263.

Osler Wade was appointed permanent liquidator, with the following committee to assist: Wm. C. Inglis, A. E. Gilverson, F. L. Cousins, of Toronto, and J. Payette, of Penetanguishene, Ont.

Ottawa, Ont.

Tenders for the proposed new Government icebreaker, which it was hoped to have in commission by November, 1921, are proving substantially in excess of the parliamentary appropriation of $2,000,000. Three tenders have been received by the Marine Department, one from Halifex, another from the Canadian Vickers Company, and the third from the Wallace Shipyards of the British Columbia, all of which are regarded as very excessive by the department. The estimate of the Wallace Shipyards was the lowest of the three received. In view of the excessive tenders it seems likely that the work of building the icebreaker will not be proceeded with for a while yet.

Halifax

The S. S. "Canadian Mariner" built to the order of the Canadian Government was launched at Halifax on the 4th September. The ceremony will be performed by Mrs. Roy Wolvin.

Four ship are now under construction at Halifax by the Halifax Shipyards for account of the Canadian Government, government type of 8,350 tons each.

At the luncheon which followed the launching, the General Manager of the Halifax Shipyards, Mr. McLurg, announced the possibility that a 10,000 ton oil-tanker would be laid down on the berth just vacated by the "Canadian Mariner."

Japan to Roll Ship Plates of Large Size.

In view of the difficulty Japan has in obtaining ship plates, the announcement of the completion of a new mill devoted to the production of these is of interest. Primarily the output will be used for naval purposes, but plates for mercantile shipping to Reuter, the cost of the new addition to the Imperial Steel Works at Yawata is 4,000,000 yen. The capacity of the plant is 100,000 tons of steel plate per month, and plates as large as 60 feet long and 11 feet wide can be manufactured. This is the first time that steel plates of this size have been manufactured in Japan.

THE IRON ORE MINES AT WABANA NEWFOUNDLAND

The Scotia Mine is producing 1100 tons daily, of which 98 per cent. is machine-loaded ore. There are now eight mechanical loaders in the submarine territory, namely, four Thew shovels, two Myers-Whaley loaders, and two Armstrong loaders. The use of mechanical loaders is being found of much advantage in advance work, the rate of progress of headings and leading places being much helped thereby.

The sale of ore for outside shipment has not yet resumed pre-war volume. It is reported that the Dominion Steel Corporation is about to ship ore to Middlesboro, England. This Company has not hitherto sold much ore to outside parties, but the Scotia Company was in previous years a heavy outside shipper. There is little doubt that with the reduction of freight rates likely to take place the shipment of ore to Europe, and to the United States, will assume important proportions once more.

FOUNDRY PROVIDES TECHNICAL INSTRUCTION FOR EMPLOYEES

The Homer Furnace Company, of Coldwater, Michigan, having been bothered by the scarcity of molders and experienced foundry foremen have commenced the Coldwater School of Foundry Technology, at which will be taught, to those who desire to fit themselves for executive positions in foundry work, the technical part of the business. The instruction will be given by arrangement with McLain's System, Milwaukee.

POLICY OF THE BRITISH COLUMBIA GOVERNMENT IS DEFINITELY TO ENCOURAGE IRON INDUSTRY.

At the Nelson Convention, held July 20th to 24th, the Minister of Mines, Hon. William Sloan, devoted much time in his remarks to the question of the encouragement of an iron industry in the Province. There has been some criticism of the Provincial Government's action in putting iron ore areas under reservation. Mr. Sloan denied that, as had been stated, all iron ore in British Columbia had been put under reserve. Only a small area carrying iron in the Clinton district had been so reserved under the powers granted him. The large area of iron-ore (limonite and hematite) in the Taseko or Whitewater district, estimated by the Government Engineer to contain possibly fifty million tons of ore had been so reserved, the Government believing that this body of ore, so suitable to be mixed with magnetite, should be held out of possible speculation so that nothing might interfere with the initiation of an iron and steel industry in the Province.

The Possibility of an Iron and Steel Industry in British Columbia.

On this important matter the Minister spoke at length as follows :

"It seems to me that the time is propitious for action on the part of capital. There is no question that we have the magnetite ores necessary for the maintenance of a 300-ton a day plant and, if the exploration now in progress in the Taseko River district results as favourably as Mr. Brewer's report would indicate, we will have all the fluxes required. There now are two parties in this district—one having been sent into the field by the Provincial Government. Mr. F. J. Crosland, B.Sc., the well known mining engineer and geologist, being in charge—and the other under Mr. J. D. MacKenzie, of the Canadian Geological Survey. Mr. Crosland's work is to establish as far as possible the tonnage of ore available, and that of Mr. MacKenzie is to make a geologist and topographical survey. There also are some high-grade red hematite deposits on the Bull and Sand Rivers, Kootenay District. This ore is known to be of excellent quality, and last year Mr. Langley, District Mining Engineer, was instructed to make an examination of the property. Owing to his many duties because of the extent of his territory he was unable to get the work done but, now that he has an assistant, the inspection will be made and we will await the report with interest.

"Six years ago the development of the magnetite ores of British Columbia and their actual commercial utilization involved problems which seemed insuperable because of the advantages of the East over the West in respect of cost of materials, labour, etc. Pig-iron, I am competently advised, now can be produced as cheaply in British Columbia as in Pennsylvania and other industrial centres of America. Ores cost roughly $7.00 a ton at the lower Lake Superior ports, or approximately $7.50 a ton at the Eastern furnaces; the cost of British Columbia magnetites landed at some point within easy reach of fuel could not be more than $4.50 a ton—in fact such a figure would allow those delivering the ore a good profit. As to the cost of fuel—the former difference favoring the East has been eliminated, as coke which before cost the Eastern manufacturers from $2.00 to $2.75 a ton, is now costing them between $11.00 and $12.00 a ton, at which figure it should be possible to secure it in British Columbia.

"Two tons of iron ore approximately are required to produce a ton of pig iron. In the East this ore is worth at the furnaces about $15.00, while in this province it could be had for about $9.00, which is a liberal estimate. One and a quarter ton of Eastern coke is necessary to produce one ton of pig iron, which means an expenditure on fuel at present prices of about $13.75, while before the war it cost something like $4.00. Under these circumstances it would appear that British Columbia now would not be at a disadvantage in respect to the production of pig iron.

"The cost of production in this province of one ton of pig iron, by blast furnace and under existing conditions as sketched, has been placed at $33.00 as follows:

Two tons of ore at $4.50	$ 9.00
One and a half tons of coke at $10	15.00
Three-quarters of a ton limestone at $4	3.00
Labor and Overhead Costs, etc.	6.00
	$33.00

"For purposes of comparison it is interesting to note that the last Eastern quotations available follow: Bessemer, $42.50; basic, $43.00; foundry, $43.00 to $45.00. While there are no official figures at hand regarding the Western market price of pig iron there is no doubt that with freight and cost of handling added the material would be much more expensive on the Coast. This is proven by the fact that the Purchasing Agent of Yarrows, Ltd., Esquimalt, on inquiry, stated that they paid $75 a ton for their last shipment of pig. As to freight rates per ton of pig from Ontario it runs to $14.80 a ton; from Quebec $15.80; and from seaboard and U. S. points, $16.60 a ton.

"As to the market possibilities, which of course is a matter of the utmost importance, it seems to me that there it no doubt that the product of say a 300-ton blast furnace could be absorbed in the Canadian and American West. If there is any doubt of the market now available taking care of this product it seems to me that the time is opportune to ask the Dominion Government to assist by the installation at one of the Pacific Coast terminals of the two National Railways of car shops and all the manufacturing plant that that implies. Hon. J. D. Reid, Minister of Railways and Canals, is in British Columbia this week and it seems to me that he should be approached to this end. I know that it was the fixed policy of the Mackenzie and Mann interests, had they been able to discharge the vast financial obligations they shouldered, to provide such car shops. Should the Dominion Government do this it would mean that a large part of the product of a 300-ton a day iron blast furnace would be taken care of and, no doubt, the establishment of the industry assured. This would be an indirect, though effective way for the Federal Government to discharge the responsibility it unquestionably has to assist in the opening up of our iron ore resources. As you know, it was mainly through the bounties and bonuses granted by the Dominion that the Eastern Canadian iron and steel industry was put on its present flourishing basis. If we cannot get this treatment it seems reasonable to ask that their railway policy be shaped along such lines as will result in the encouragement of the same industry in the West, where the native resources are of just as high quality and just as extensive. This, too, would appear to be the moment to strike from the fact that the launching of the British Empire Steel Corporation merger, with a capitalization of $500,000,000, has been announced with-

in the past few weeks. Included in this combination are the iron and steel manufacturing interests of Eastern Canada, and the question occurs in considering the move, whether this tremendously powerful industrial and financial combination will retard or hasten our ambitions for an iron and steel industry in this province. Certainly it is not a time for sleep and British Columbia should not hesitate to strongly press her claims for recognition.

"I draw attention to the fact that the Provincial Government has not overlooked or shirked its responsibility. This is evidenced not only by the fact that a bounty now is offered on the production of pig iron from British Columbia and which was last session extended for a period of five years, which, in the case of a 300-ton plant this bounty will entail an outlay of about $1,000,000, but as well by the activity of my Department in the obtaining of all possible information regarding the resources of the province. We have had many applications for assistance for the establishment of an iron and steel industry from private enterprise, but thus far all have required the endorsement of bonds to from 50 per cent to the full value of the plant. The Government's position is that, if it is necessary to go that far, it would be better that the industry should be vested in the people and operated for the people's benefit. The assembling of data is continuing to the end that, if it becomes necessary, the Government will be in a position to give serious consideration, basing the same on authentic information, to the advisability of the announcement of some such policy."

CANADA AS A PRODUCER OF IRON ORE.—THE INFLUENCE OF COAL LOCATION.

(Bulletin of the C. I. M. & M.)

Perhaps the most important topic discussed at the meeting of the Ontario Mining Association, which was held at Sudbury during the past month, was the deplorable position of Canada as a producer of iron ore, and the status of the domestic iron and steel industry generally. The consensus of expressed opinion was that Government assistance in the beneficiating of Ontario ores to smelter grade is, in principle, highly desirable, and the belief was further expressed that it is commercially practicable to use coal from Alberta in smelting these ores. The outcome of the discussion was the appointment of a committee to present the views of the mining industry of Ontario before the Government Commission now investigating the possibilities of the iron ore industry.

As to the desirability of possessing and building up a vigorous domestic iron and steel industry there is no room for argument. One has only to consider the leading nations of the world to find what a very intimate connection there is between the production of iron and steel and national growth and prosperity. Indeed, the one is practically a measure of the other. This is no less true in the case of Canada, and for years the iron and steel industry has been our leading manufacturing industry. Our position would be entirely satisfactory, were it not for two disturbing factors: practically all the iron ore, and a very large proportion of the coal, used in making our iron and steel is imported; and moreover, the production falls far short of our requirements. To put the case more concretely, iron ore and iron and steel products to the value of one hundred and eighty-six million dollars were imported into Canada during 1918. In the light of the figures there would appear to be a very good *primâ facie case* for urging the Government to give material assistance to the development of our own iron ore resources. But one must not lose sight of the fact that an iron and steel industry can not be built up on iron ore alone. A plentiful and assured supply of cheap fuel is essential. Examining the position in Ontario we find there is no coal, and, so far as is known, there are no large high-grade deposits of iron ore—practically all the ore now being raised in the province requires beneficiation. This indeed constitutes one of the reasons for urging Government assistance, in order that the domestic product may compete more favourably with imported ore. The development of the iron mining industry everywhere in Canada is most desirable. But even granting that a bounty might have the effect of encouraging the development of Ontario's iron fields to such an extent that the furnaces could be fed entirely or mainly with Ontario ore, we would still be very far from having a purely domestic and independent iron and steel industry in Ontario. The suspension or cutting off of fuel supplies would be just as serious under such conditions as it would be today.

In this connection, therefore, it is of interest to note that the Ontario Mining Association placed on record their belief that the use of Alberta coal is commercially practicable. It would be interesting to have the data on which this belief is based. If it is well founded, might it not be argued that, if only Ontario ore and Alberta coal were in question, the ore would be sent to the coal, and not *vice versa.* This at least is a fairly general economic rule, and if it applies in this case we arrive at the curious conclusion that the Ontario steel industry must either disappear, or must continue to rely, as at present, on foreign ore and foreign coal. In other words, it would indicate that, if a large tonnage of iron ore can be developed and produced in Ontario, with or without Government assistance, and if our aim is to establish and build up a really independent Canadian iron and steel industry in central or mid-western Canada, the logical centre for such an industry is in the coal fields of Alberta. However this may be, it in no way affects the general principle as to the desirability or probable effectiveness of the policy of bonusing the production of Canadian iron ores.

SECOND ANNUAL WESTERN MEETING OF THE CANADIAN INSTITUTE OF MINING AND METALLURGY.

The Second Annual Western Meeting of the C. I. M. & M. is to be held at the Hotel Fort Garry, Winnipeg, on October 25th, 26th and 27th.

The Secretary of the Local Committee is Mr. W. W. Berridge, and all members who desire hotel accomodation are requested to let Mr. Berridge know at once.

It is understood the Local Committee has succeeded in interesting local bodies and enterprises to a very considerable extent in the forthcoming meeting.

So far only a sketch of the programme is possible, but it is understood the Institute will be the guests of the Manitoba Government, the City of Winnipeg and the Winnipeg Board of Trade at luncheons on the three days of the meeting. Special attention is to be paid in the papers to the coal trade in the West and the possibilities of an iron and steel industry in Western Canada.

The Design of Chutes and Ore Bins

By JOHN S. WATTS, New Glasgow.

The functions to be performed by a chute, appear at first sight, to be so simple, as to often lead to failure to produce a satisfactory design, from a lack of appreciation of the vital points to be considered. Literature on this subject, is very meagre, so that the designer has practically nothing to guide him, but his own probably limited experience.

The minimum slope, which will cause the material to slide down the chute is variable for different materials, and even for the same material, under different climatic conditions, and also varies with the sizes and quantity of lumps and fines. The manner of delivery into the chute has also some effect.

Below is given a table for some of the more common materials met with, showing the slope or gradient at which they will slide under fair average conditions. That is with the material reasonably dry, with only a small percentage of fines, and the bottom of the chute, being made of smooth flat steel plates, without projecting rivet or bolt heads.

Coal in lump size, 18½° from the horizontal.
Coal in small sizes, 27° from the horizontal.
Iron ore, 38° from the horizontal.
Gravel, 40° from the horizontal.
Sand, 38° from the horizontal.

These gradients are stated in degrees from the horizontal and should be considered the absolute minimum. Whenever possible the angles should be determined by actual experiment on the material to be handled.

It should be noted, that when the material is held in the bin or chute, by closing a gate, and the material allowed to settle, the above gradients will need to be increased, by two or more degrees, depending upon its nature, to overcome the increased friction of the material when at rest.

In designing bins, the bottom should be shaped and graded in all directions, leading to the gate, at the inclination required to start the material sliding, after being allowed to settle to rest.

The effective storage capacity of a bin which will completely empty itself, is much greater than that of one of equal total capacity, which cannot be completely emptied, by gravity alone, because, that part of a bin, where the bottom layer of material refuses to move, becomes filled up and is no longer available. The angle of repose, of the material in the dead part of the bin, may be sixty degrees or more, whereas by grading the bottom of the bin, to that angle required to keep the material moving, which will not usually be more than forty-five degrees, we gain for effective use the space enclosed between the angles of forty-five and sixty degrees.

This may be more clearly understood, by referring to Figure 1, and it must be noted that the inclination to the horizontal of the two inclined surfaces, must be sufficient to make the inclination along the valley, line AA, that which is necessary to start the material sliding under the worst conditions.

It is sometimes necessary to use a twin chute, such as is shown in Figure 2, to take the material from two receiving points to one common delivery point. Obviously, the inclination along line BB, is less than the angle B, and therefore the angle O, must be made such that the angle of inclination, from the horizontal, along line BB, will be that required to cause the material to slide.

When a long chute is used, delivering on to a rubber belt, and the material is mixed lumps and fines, it will be found that the grade which is right for the fines, will be too steep for the lumps, and that the larger pieces will gather so much velocity, that they will cut the belt, and probably bounce off it.

The remedy for this, is to have the chute made in two decks, the upper deck being fitted with a screen,

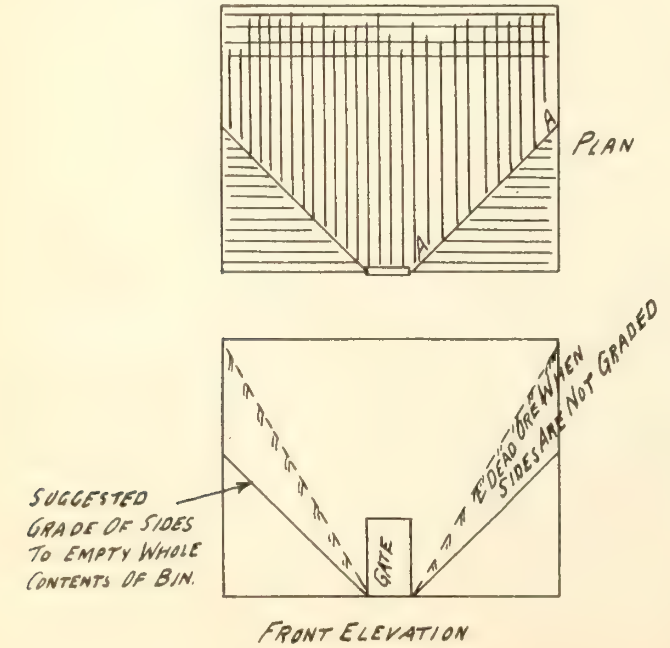


Fig. 1.

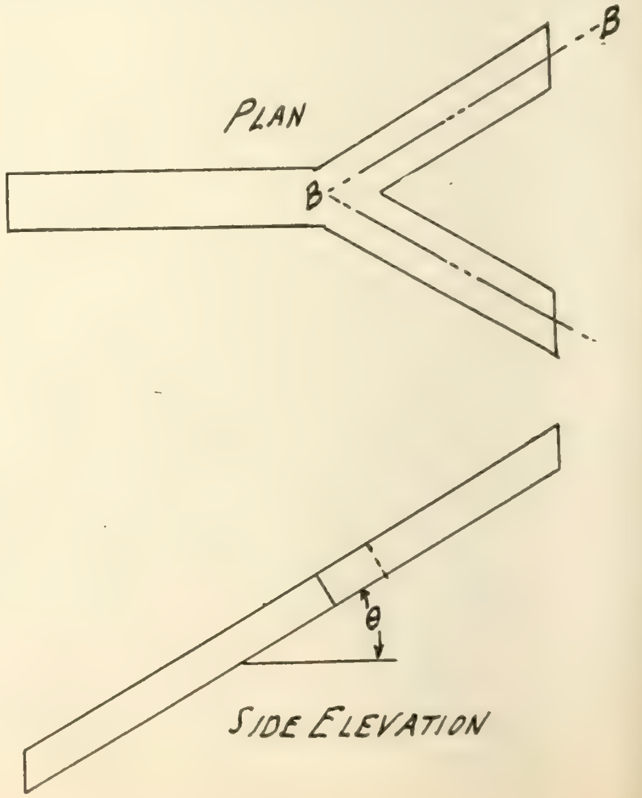


Fig. 2.

to take out the fines, which will fall into the lower deck. The upper and lower decks can then be arranged to have different inclinations, to suit the different sizes, and should preferably be hung, separately, on eye-bolts fitted with turnbuckles; so that the inclinations can be adjusted to suit, and if necessary, altered to take care of the varying velocities, due to variable climatic conditions.

When an extra long chute is required, the grade required to keep the material moving at the top, will cause it to attain a high velocity when the ore reaches the bottom. If the ore is hard, this high speed will cause the lumps to cut and abrade the belt. This can be cured by making the chute as outlined in Figure 3, the curved part of which, at the lower end, can be set so as to reduce the velocity of the material to that of the belt, and so prevent any damage to the belt at the loading point.

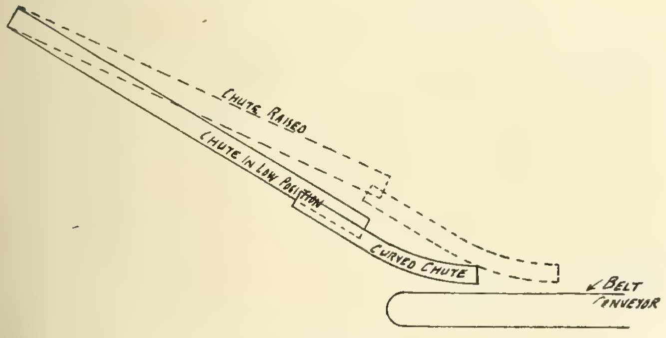


Fig. 3

By making the chute in two sections, as shown, hung on adjustable hangers, as suggested before, the grade of each chute can be adjusted independently, so as to get just the right velocity, and, at the same time keep the delivery end of the chute, just high enough to clear the belt, and avoid dropping the material on to the belt and so cutting the surface.

If, in addition, the chute is made a double decked one, as described above, the fines will be fed into the belt first, and give a perfect protection to the belt against damage by the larger pieces, making an ideal arrangement under all the varying conditions.

When the delivery chute, is at right angles to the belt, and the belt is to be used as a picking table, in which case, the material has to be spread over the width of the belt, in a thin even stream, to enable the impurities to be seen and removed, an effort is sometimes made to get this spreading effect, by cutting off the end of the chute at an angle of 45°.

In the plan view, Figure 4, this idea looks allright, but a study of the elevation will show that the point C, is much too high above the picking table, and the material dropping from this point will be detrimental either to the belt or to the material.

This damage can be averted, by making the line, CD, level, when the chute will appear as shown by the dotted lines in the elevation, but this gives a steeper grade along the side C, then along the side D, and destroys the even spreading of the material, by inducing the bulk of the ore to run to the point C, and leaving the rest of the chute bare.

If the material is uniform in size, and delivered to the chute in small quantities at a time, it can be prevented from travelling across the chute, by fitting

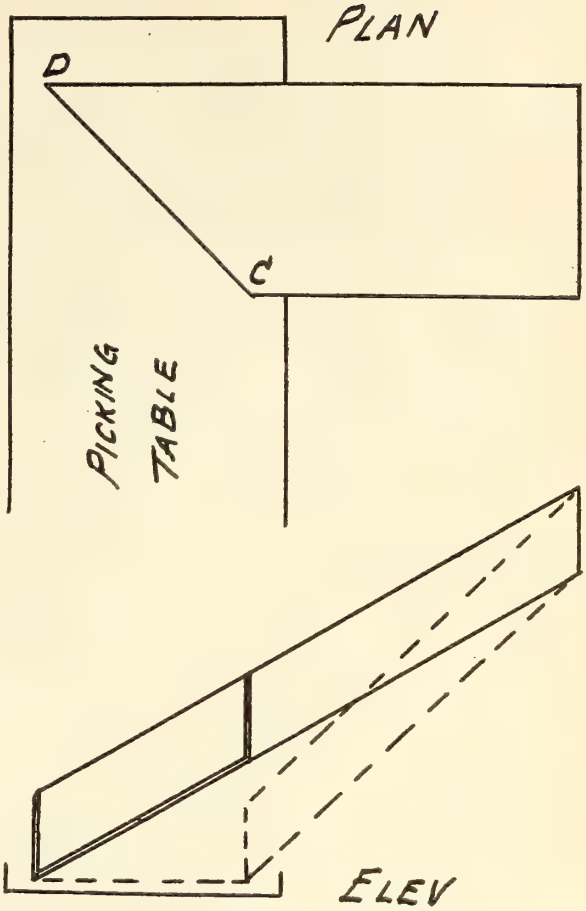


Fig. 4.

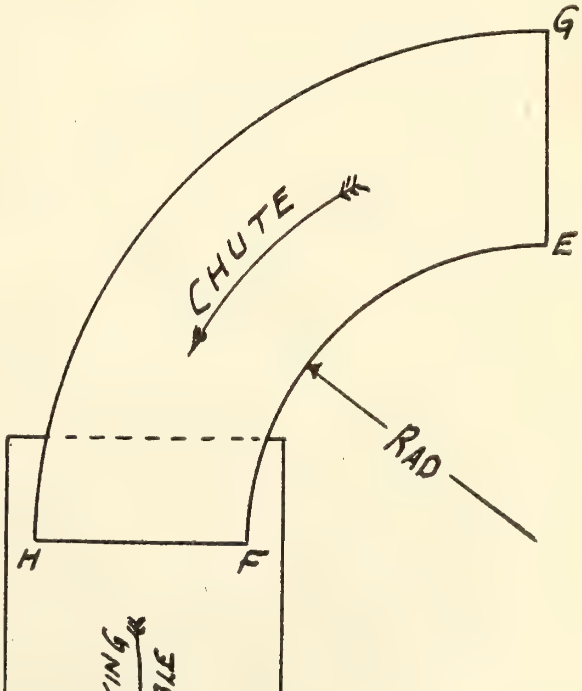


Fig. 5.

angle or the bars longitudinally along the bottom of the chute, and so forming channels compelling the material to travel parallel to the chute sides.

The neatest way however, is to fit a helical chute as shown in Figure 5. This type takes more head room, and is more expensive to make, but will accomplish the purpose more successfully, if properly designed and made, than any other type of chute.

In this helical chute, we have, as in the last one, a steeper grade along line E.F., than along line GH, but the centrifugal force acts against the tendency to fall towards point F, and if the radius of the chute, is not made too small, will give an evenly spread delivery on to the picking table. The smaller this radius, the greater will be the difference between the grades along the two sides.

Another case, that requires consideration to evolve a satisfactory chute, is that shown in Figure 6. In this case, the chute is a twin one, having one receiving end, and two delivery points, to two picking tables. The conditions to be met, are, that the grades must follow

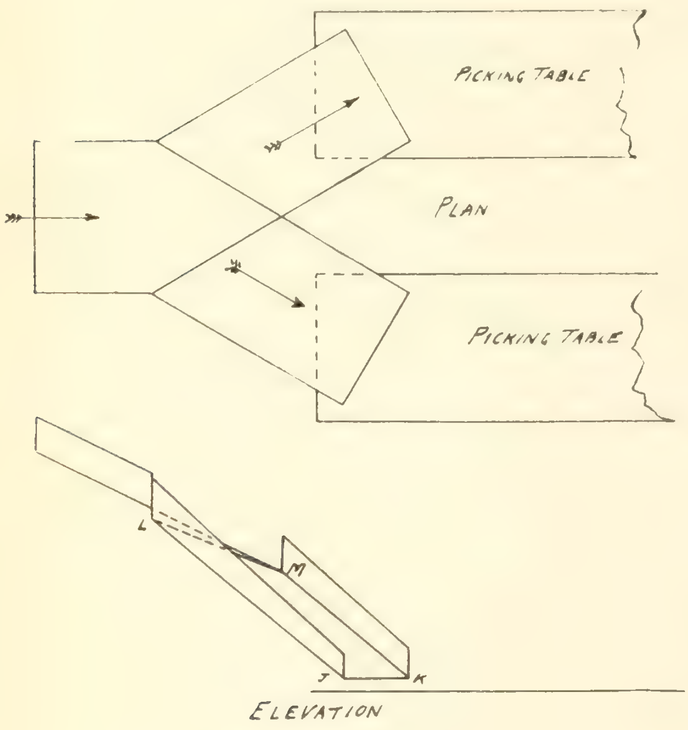


Fig. 6.

the arrow heads, shown on the plan, in order that the stream may be of even thickness across the width of the two parts of the chute.

To arrange this, it is obvious that lines LJ, and MK must be parallel, and in the same plane, and this will usually involve having a slight drop at the point L, taping off to nothing at point M. By a judicious arrangement of the respective grades in the single and in the twin parts of the chute, the drop at point L can be kept to a minimum, and sometimes eliminated This depends upon the conditions as to centers of picking tables, length and height available, and can only be determined by laying out to scale on the drawing board.

MINERALS USED IN IRON AND STEEL INDUSTRY PRODUCED IN QUEBEC IN 1919.

The Report of the Superintendent of Mines for Quebec for 1919 contains information regarding the production of minerals of interest to the iron and steel trades. During the war period, Quebec produced many of the so-called "war minerals," notably pyrites, molybdenite, magnesite and chromite. The demand for these minerals has fallen off in a marked manner.

Chromite.

Production of chromite fell to 8,184 tons valued at $223,331 compared with 23,000 tons valued at $770,-955 in 1918, and the future of the industry depends largely on whether the United States imposes an import duty on chrome.

Molybdenite.

Only one production of molybdenite is reported for 1919, namely 83,002 lbs. of molybdenite from the Moss Mine of the Dominion Molybdenite Co. Operations ceased at this mine on March 10th 1919 owing to market conditions. The deposit is not exhausted, and the mill equipment is described as remarkably efficient. Should the demand arise, the Quebec deposits will be able to produce moderate quantities of molybdenite for an indefinite period.

Magnesite.

Magnesite to the extent of 9,940 tons was produced in Quebec in 1919, being a considerable decrease from the figures of 1918. Important shipments of dead-burned magnesite were made during 1919 to most of the steel mills in the Eastern United States and in Canada, the Report mentioning the following concerns who have used Quebec magnesite with satisfaction, namely, Bethlehem Steel Co., Carnegie Steel Co., Jones and Laughlin, Atlas Crucible Co., Halcomb Steel Co., Ludlum Steel Co., and all the Canadian steel plants. Like chromite, the future of the Quebec magnesite industry depends on whether or not a prohibitive protective tariff is imposed on importations from Canada into the United States.

Copper and Pyrites.

Production in 1919 was 53,965 tons valued at $447,-623 comparing with 125,446 tons valued at $1,319,690 in 1918.

Activities of all the mines were affected during the early part of 1919 by the lack of demand for pyrites and the low price of copper.

The premier of Canada says the tariff policy of this country should be to keep Canadian workingmen in Canada, to make goods in Canada, and to give Canadian industries just enough advantage in the Canadian market to make it pay them better to stay here and expand, than to diminish their plants and leave. Mr. Meighen announces his Government intends to revise the tariff to secure these ends; that wherever a tax exists that is not necessary, it will be wiped out, that no interests, however powerful, will get more; and that no wreckers or theorists, however enthusiastic, will be permitted to imperil the well-being of the country by blindly fixing less. Whether Mr. Meighen's government can carry out this programme or not time alone will tell, but that Mr. Meighen has outlined the specification of national well-being few will deny. The phrase "wreckers or theorists" is a very happy one. Only too often the terms are synonymous, and while the theory is beautiful, the result is most dire.

Beneficiation of Lake Superior Ores

From CROWELL AND MURRAY'S "Iron Ores of Lake Superior".

Shipments of iron ore from the Lake Superior district up to and including 1919 reached the total of 946,545,917 tons. The state tax commission of Minnesota estimated the reserves of iron ore in Minnesota in 1919 at 1,394,923,451, apportioned among the ranges as follows: Mesabi, 1,325,035,574; Vermilion, 11,059,237; Cuyuna, 58,828,640. The first assessments equalized by the Minnesota tax commission, in 1907, were on a basis of 1,191,969,757 tons of merchantable iron ore in the ground. The assessed valuation was $191,706,682. Since that year approximately 420,000,000 tons of iron ore have been shipped from Minnesota, but despite this, according to the tax commission's records, the 1919 record of merchantable iron ore in the ground was 202,953,694 tons greater than in 1907, and the assessed valuation was $97,233,693 greater, due to new developments. In addition to the commission's estimate of merchantable tonnages it was stated in 1919 that there were approximately 175,000,000 tons of iron ore of record in the tax commission's office, the grade and character of which were such that market conditions and standards made it nonmerchantable, but which at some future time may have a market value.

Only seven mines in the Lake Superior district shipped more than 1,000,000 tons of ore in 1919, while this output was exceeded by more than 12 mines in 1918. Those which shipped more than 1,000,000 tons in 1919 were: The Canisteo, which shipped 1,255,668 tons; Hartley-Burt-Palmer, 1,064,838 tons; Hull-Rust, 5,100,555 tons; Kerr, 1,693,389 tons; Missabe Mountain, 1,260,095 tons, and the Mahoning, 1,237,168 tons, all of the Mesabi range; and the Norrie group on the Gogebic range, which shipped 1,335,468 tons.

Records of shipments have a bearing on the subject of beneficiation of ores as showing the immense tonnages that are being removed from the Lake Superior district in proportion to the estimated reserves. In another chapter in this book the average analyses of the iron ores since 1902 are presented, showing the variation in the quality of the ores, and it is interesting to note in this connection that if the average content of iron holds up in the next ten years as well as it has since 1902, the average percentage of iron of all grades of iron ore in 1920 will be about 51 per cent, which is not appreciably lower than the present average. But while the average quality of the ore has been well sustained by means of careful mixing and analysis, the time is not far distant when the percentage of high-grade ore will begin to show more of a decline ; that is, there will be less tonnage of the better grade of ore for mixing with the leaner ores, and this must inevitably show in the record of analyses.

It is with this contingency in mind that some of the largest producing companies are devoting attention to the benficiation of ores. As a general proposition, buyers of Lake Superior ores demand a product of the highest quality available and comparatively few ores of inferior grade have been shipped. If the leaner ores are smelted in their natural condition, the cost of producing pig iron will increase, due not only to the fact that additional ore, coke and limestone will be required to produce a unit amount of pig iron, but also to increased operating and overhead charges at the furnaces. These factors are compensated for, to some extent by the lower price of ores of inferior grade, but it is probable that the solution of the problem lies in the concentration of the lower grade of ore and the production of a high-grade shipping product.

At present concentration is being adopted in a number of instances in the Lake Superior region, but it is probable that the present policy of taking the best of ores available will be adhered to until operators are forced by necessity to resort to the lower grade ores. Recent estimates of the iron ore resources of the Lake Superior region show that the ores that are now of commercial grade will be exhausted in a comparatively few years and that the great bulk of the iron ore resources of the region will average less than 45 per cent in iron. Concentration methods that will make this low-grade ore available are sure to become of increasing importance.

At present there are three methods of beneficiating ores as found on the Mesabi range. Certain ore deposits comprise an ore which is merchantable, but which contains a large percentage of fine sand and not infrequently a deleterious percentage of paint rock, rendering it unmerchantable as mined. The fine sand and paint rock are capable of being removed by simple washing. The machine used for this washing process is a log washer which does not differ in principle from the old Thomas log washer used for years for washing ores in Pennsylvania and certain localities in the South. Mesabi range practice has, however, greatly improved the mechanical construction of this machine in order to reduce maintenance and increase tonnage.

Certain other deposits consist of ore plus a variable percentage of rock. The ore is merchantable but the presence of the rock renders it unmerchantable, unless the rock be removed. Ordinarily the rock is of such size that screening with ordinary stationary grizzly bars answers the purpose, although an improved form of screening machine or grizzly, the chain grizzly, has been evolved in the past few years. A third type of ore deposit comprises a material which is all merchantable but which contains in addition to the reasonably fine ore, chunks of ore too large to be shipped to the furnace. To make such a deposit merchantable it is necessary that the chunks be crushed to merchantable size and this involves the removal of the fines and then the crushing of the chunks.

Recently the Oliver Iron Mining Co. erected two large plants, one at Eveleth, Minn., and other at the Morris mine, Hibbing. Other companies also have been active, and it is now estimated that there are on the Mesabi range approximately 12 washing and screening plants.

The ore tributary to the Oliver's plant at Eveleth is both wash ore and crush ore and consequently the plant really comprises two plants, the washing side and the crushing side. The washing side comprises a chain grizzly for screening out the oversize which is too large to be fed to the washer. If the oversize of the chain grizzly consists of ore in fairly large chunks

this ore passes to a No. 8 gyratory crusher and then conveyed to the shipping. If, however, the oversize of the chain grizzly is low grade rock it is delivered to a rock bin and then conveyed to the rock dump. The throughs from the chain grizzly are conveyed by a belt conveyor to a revolving tremmel with 2-inch holes and the throughs from the tunnel pass to a log washer. This log washer differs from the log washers in use at the other washing plants in that it is 35 feet long. In all the other washing plants on the range, the overflow or tails from the log washers pass to settling tanks and then to 18-inch log washers, locally known as "turbos". By increasing the length of the logs from 25 to 35 feet and giving the logs a wide and slow overflow the material which in other plants receives a secondary washing in the "turbos" is retained within the logs, thus dispensing with the second washing of the fines.

The other side of the Eveleth plant is designed to handle such ores as contains large chunks, all sufficiently high grade to warrant crushing. It comprises a chain grizzly and a jaw crusher, 48 x 60-inch opening. The throughs from the chain grizzly are conveyed by a belt to the shipping bin. The chain grizzly acts also as a conveyor so that its oversize is fed directly to the crusher. The crushed ore is fed on to the same belt that conveys the throughs from the grizzly to the shipping bin.

In the Morris pit there are deposits of ore which contain low-grade rock. This pit also contains deposits of ore much of which is in the form of large chunks. The Morris plant, therefore, is practically two plants, one for crushing, and the other for screening. The crushing plant comprises a chain grizzly, the throughs from which are discharged to a belt conveyor and conveyed to the shipping bin. The oversize, consisting of large chunks of merchantable ore are conveyed by the chain grizzly to the 48 x 60-inch jaw crusher, and the product of this crusher feeds on to the same belt and delivers in the same shipping bin.

Wet concentration methods also are now in use at the Trout Lake plant of the Oliver Iron Mining Co., near Coleraine, at the Hawkins, Quinn-Harrison, Grosby, York and La Rue mines in the Nashwauk district, and at the Madrid mine at Virginia, on the Cuyuna range, at the Rowe mine and on the Marquette range at the American mine, near Diorite.

The Trout Lake plant is located in what is known as the Coleraine district on the west end of the Mesabi range and receives ore from a number of mines operated by the Oliver Iron Mining Co. The ore is received at the mill in railroad cars operated over an enormous earth fill which is approximately 4,000 feet long, terminating in a steel trestle, 650 feet long and having an elevation of 90 feet above the railroad tracks that are below the shipping bins. The ore is dumped from the cars into receiving bins and is handled in the mill entirely by gravity. The mill consists of five units, each unit being capable of independent operation. Each unit consists of a receiving bin having a capacity of 450 to 500 tons, from which the ore is sluiced by water jets over a bar grizzly into a revolving conical screen with 2-inch openings. The oversize from the screen is delivered to the shipping bin by a picking belt, and the undersize is treated in two 25-foot log washers. The concentrates from the log washer are discharged directly into the shipping bin and the tailings are de-watered and treated in two 18-foot "turbos" or small log washers. The concentrates from the turbos are discharged directly into the shipping bin and the tailings are de-watered and treated on 20 Overstrom tables. The concentrates from the table are elevated by Frenier pumps to dewatering tanks and discharged directly into the shipping bin. The tailings from the mill are collected by launders in the mill basement and are discharged into Trout Lake by a concrete launder that is approximately 2,000 feet long. The plant was completed in 1910, and its capacity is approximately 3,000,000 tons of crude ore per season.

The plants in the Nashwauk district, with the exception of that at the La Rue mine, embody the same principles as the Trout Lake plant; the distinctive features being in the methods of handling the crude ore which is received in bins located outside of the plants and is elevated to the tops of the mills by means of troughed belt conveyors, which discharge directly onto grizzlies doing away with receiving bins at the tops of the mills. The Hawkins plant was completed in 1912, the Quinn-Harrison in 1914, and the Crosby plant in 1916.

The plant at the La Rue mine differs from the other plants on the Mesabi range, in that the turbos and table in the ordinary plant are replaced by Wetherbee concentrators.

One of the most interesting of the new plans proposed for the concentration of ores, from the standpoint of commercial possibilities for utilizing immense tonnages of low-grade ores, is that pertaining to magnetic separation of the ores as found on the eastern portion of the Mesabi range.

The deposits of the east end of the Mesabi range cover very large areas, and consist of the same taconite that produces the hematite of the central and western Mesabi. It is not deeply covered with drift, but outcrops boldly in large masses. It is not concentrated locally into enriched bodies separated by leaner areas, but is all a fairly uniform, hard, banded, unaltered chert, carrying about 25 to 30 per cent iron as magnetite.

The Mesabi Iron Co., organized by Hayden, Stone & Co., and under the direction of D. C. Jackling, has taken over these deposits and is building a concentrating plant at the new town of Babbitt about 14 miles east of Mesaba, Minn. This plant is to have a capacity of 2000 to 3000 tons per day and is based on the application to this low-grade material of the methods which have made the so-called Prophyry copper properties so successful.

In 1916 an experimental mill was built in Duluth containing full sized machinery and capable of handling from 100 to 200 tons daily. A considerable tonnage of material was concentrated during 1916, 1917 and 1918. The work showed that the resulting product could be varied, almost at will, between 60 per cent and 70 per cent iron and .006 per cent to .030 per cent phosphorus, and that this could be made on a large scale well within the limits of cost set by iron trade conditions. A small special cargo was sent down the lakes late in 1918 assaying 63.27 per cent iron (natural and dry) and .008 per cent phosphorus, but it is assumed that large-scale shipments will normally be of a bessemer product carrying about 63 per cent iron and .020 per cent to .030 per cent phosphorus. This material is a sinter, carrying only traces of sulphur and titanium, with silica between 6 per cent and 10 per cent and alumina, lime, magnesia and manganese, each below 1 per cent. Some of the iron in

this sinter is hematite and some is magnetite, the percentages varying according to the treatment given on the sintering machine. Like the analyses, this hematite percentage is within reasonable control. Sinter made from finely ground magnetite has much the structure of coke, being firm yet porous, and gives good account of itself in the blast furnace. The methods to be used in the plant now under construction are about as follows :

1—Stripping : Very light. Much of the deposit has no covering at all.

2—Quarrying : Side hill work. Faces 40 to 60 feet high. Churn drill holes and heavy blasting.

3—Steam Shovel.

4—Standard gage railroad to mill.

5—Extra heavy primary crushing plant to 2-inch size.

6—Dry magnetic separators in closed circuit with 72 x 20-inch rolls, reducing to about 1-8-inch size and discarding about 50 per cent of the material as hard waste rock of all intermediate sizes, suitable for concrete work, road building and rairoad ballast. A shipping concentrate can also be taken out here and shipped without further treatment if desired.

7—Ball mills grinding the 1-8-inch partly concentrated material wet to 80 to 100 mesh.

8—Wet magnetic separators, Davis type.

9—Sintering plant.

No one of these operations is novel or untried. Each is in successful use somewhere else with costs and results well known. The quarry, railroad and coarse crushing end of this plant will be in operation in the late fall of 1920 if labor and railroad conditions permit. The entire plant should be in production during the entire season of 1921. It is being built on the unit basis, so that additional capacity may be added at will up to almost any amount desired.

IRON ORE AND PIG IRON PRODUCTION IN ONTARIO FIRST SIX MONTHS OF 1920.

Shipments of siderite ore from the Magpie mine by the Algoma Steel Corporation and of briquettes produced from magnetite ore by Moose Mountain, Ltd., Hutton township, totalled 13,962 short tons valued at $74.073. The first mentioned used its entire output in the blast furnaces of the Corporation at Sault Ste. Marie, while the latter shipped its product to Quebec and the United States. The new Helen mine of the Algoma Steel Corporation has been diamond drilled and it is estimated that over 100 million tons of siderite are available for mining.

The pig iron output by the Algoma Steel Corporation at Sault Ste. Marie, Steel Company of Canada at Hamilton and Canadian Furnace Company at Port Colborne was 321,826 short tons valued at $8,255,916. Only 58,387 tons or 8.94 per cent of the total of 653,-137 tons of ore charged to the 7 furnaces in blast was of domestic origin, the balance being imported from the United States. Furnaces of the Midland Iron and Steel Co., Parry Sound Iron Co., and Standard Iron Co., were not operated during the period. The output of steel from pig iron was 337.048 tons valued at $1,661,570. These figures do not include any secondary steel produced in the electric furnace from scrap iron and turnings.

IRON AND STEEL IN CANADA 1919.

Revised Statistics and Comparison with 1918.

(Division of Mineral Resources and Statistics, Department of Mines, Ottawa.)

	1918	1919
	Short tons.	Short tons.
Iron ore—Shipments:		
Hematite	485	125
Magnetite	39,396	7,083
Roasted siderite	170,827	189,962
Bog ore	900	......
Total shipments	211,608	197,170
Sold for export	118,472	5,883
Imports (Customs record)	2,200,838	1,783,098
Charged to blast furnaces:		
Canadian ore	96,745	78,391
Imported ore	2,146,995	1,674,194
Charged to steel furnaces	48,599	32,409
Shipment from Wabana, Newfoundland	848,574	499,972
Pig Iron: (blast furnace) :		
Nova Scotia	415,870	285,087
Ontario	684,642	747,650
Pig Iron—electric furnace	32,031	7,701
Pig Iron production by grades :		
Basic	966,409	580,426
Bessemer	47,446	15,338
Foundry and malleable	178,099	322,017
Total production	1,195,551	917,781
Exports of pig-iron	2,130	63,605
Exports of ferro-alloys	23,781	22,449
Imports of pig-iron	67,396	35,800
Imports of ferro-alloys	35,284	16,222
Steel:		
Production of ingots and castings	1,873,708	1,030,342
Production of ingots by classes:		
Open hearth	1,684,317	983,236
Electric steel	115,615	8,741
Other steels	339	1,062
Direct castings by classes:		
Open hearth	62,017	24,259
Electric	3,515	6,761
Other castings	8,005	6,283
Imports of steel ingots, billets and blooms from U.S. (U.S. Customs record)	277,012	11,452
Production of steel rails	162,747	316,304
Production of wire rods	154,789	153,723
Imports of wire rods	42,838	34,903
Imports of tin plate	72,844	43,407
Value of total exports of iron and steel goods	61,772,613	84,058,924
Value of total imports of iron and steel goods	$178,340,779	$181,332,310

SHEET MILL CREW MAKES PRODUCTION RECORD

What is believed to be a record production of sheets as made by a crew at the plant of the Falcon Steel Company, Niles, Ohio, on August 20th.

One of the crews of their No. 7 hot mill, turned out 744 pairs of 22 gauge—30″ x 72″ sheets in 8 hours. This production was made possible by the speeding up of the heating in furnaces fired with powered coal where the Quigley System is in use.

PIG IRON PRODUCTION IN CANADA, DURING THE FIRST HALF OF 1920.

The total production of pig-iron in Canada during the first half of 1920 according to statistics collected by the Mines Branch of the Department of Mines, Ottawa, was 502,667 short tons (499,891 tons made in blast furnaces and 2,796 tons made in electric furnaces) as compared with a production of 524,977 tons during the first half of 1919, and 392,804 tons during the second half of 1919. The average monthly production of pig-iron during the first half of 1920 was 83,778 tons as compared with an average monthly production throughout 1919 of 76,482 tons.

The blast furnace plants active during the first half of the year were those of the Dominion Iron & Steel Co., Ltd., at Sydney; the Nova Scotia Steel & Coal Co. Ltd., at North Sydney, N. S.; the Algoma Steel Corporation at Sault Ste. Marie, Ont.; the Canadian Furnace Co., Port Colborne, Ont., and the Steel Company of Canada, Ltd., at Hamilton, Ont.

The blast furnace plants at Midland, Parry Sound and DeSeronto, Ont., were idle throughout the period.

Pig-iron was made from scrap iron and steel in two plants, the Shawinigan Foundries, Ltd., Shawinigan Falls, Que., and the Hull Iron & Steel Foundries. Ltd., Hull, Que.

The monthly production of pig-iron in short tons since 1916 has been as follows:—

	1916	1917	1918	1919	1920 *
January	....	89,187	74,238	103,963	81,494
February	....	83,801	78,507	86,840	70,864
March	....	103,789	96,848	91,286	77,155
Avril	....	100,789	104,331	93,359	86,303
May	....	108,891	104,867	83,059	97,593
June	....	99,998	103,037	66,470	89,258
July	92,012	93,499	109,723	60,927	......
August	87,864	100,727	96,164	67,404	......
September	102,744	100,690	95,102	56,806	......
October	113,608	103,277	106,962	56,049	......
November	104,436	97,905	106,585	73,092	.....
December	106,496	87,152	119,186	78,526	.....
	1,169,257	1,170,480	1,195,551	917,781	.....
Average monthly	97,438	97,540	99,629	76,482	83,778

BELCHER ISLAND IRON ORES.

In the Engineering and Mining Journal August 28 number, Mr. E. S. Moore, who examined iron ore deposits of Belcher Islands in 1916 says that: "The maximum thickness of the iron formation is 275 feet, but the great bulk of the formation is hard, highly siliceous jasper with bands of slate or greywacke, the whole averaging less than 30 per cent. iron. One band 35 feet thick, measured in the best portion of the formation and carefully sampled, averaged 30.1 per cent. iron, with 37.97 per cent. silica, 0.039 per cent. phosphorous, and a trace of sulphur. There are considerable bodies of this low grade material close to tidewater. The highest grade sample taken and analyzed ran 50.7 per cent. iron.........There has been much discussion as to whether the iron deposits of the Belchers are of economic value. It is my opinion that they are so lean, and the climate conditions are so unfavorable, that they cannot be worked at present. Electric smelting, with power developed on the falls on the numerous rivers entering the east coast of Hudson Bay might be employed, but even then the conditions do not seem promising."

Some of those who have examined the Belcher Island iron ore deposits during the past few years are much more favorably impressed with them than Dr. Moore. No report of the recent examinations is, however, available for publication.—R.E.H.

RAPID INCREASE IN BY-PRODUCT COKE OVENS IN UNITED STATES

In connection with statement that the tar supply from by-product coke ovens is barely meeting the needs of consumers comes the announcement that 853 such ovens are now under construction, scheduled for completion before the close of the current year. In 1919, 758 new ovens were completed and 510 added to existing plants.

Owing to the great demand for coal by-products and the more profitable production of coke in this manner, there is a rapid growth in the extension of the by-product coking industry. The iron and steel industry is responsible for virtually all the developments of this character.

Coke oven production of tar in 1918 was approximately 263,000,000 gallons, or about two-thirds of the total output. The new by-product plants lately completed or building will much increase this output.

Companies now building coke ovens are: Birmingham Coke & By-Products Co., 50; Sloss-Sheffield, 120; Tennessee Coal, Iron & R.R., 77; St. Louis Coke & Chemical Co., 80; Donner-Union Coke Corp., 150; Lackawanna Steel, 60; Cambria Steel, 60; Jones & Laughlin Steel, 60; Pittsburgh Crucible Steel, 100; Domestic Coke Corp., 60; and Steel & Tube Co. of America, 36.

SILICA BRICK MADE IN 1919

The quantity of silica (refractory) brick produced in the United States in 1919, according to an estimate made by the United States Geological Survey, Department of the Interior, was the equivalent of 216,363,000 9-inch brick, and was valued at $11,798,000, a decrease of 120,199,000 brick and of $8,190,000 from 1918. The average price per thousand decreased from $59.39 in 1918 to $54,53, in 1919. The output in 1919, though much smaller than that in 1918, was much larger than that made in any year pior to 1916, and the value in 1919 was much larger than in any year prior to 1917.

The Fnture of Oxygen Enrichment of Air in Metallurgical Operations*

Apparent Possibilities of Applying Cheap Oxygen to Various Standardized Metallurgical Operations, Permitting Closer Economy of Blast Furnace Fuel, Reducing Atmosphere in the Open-Hearth, and Low-Silicon Iron to Converters.

By F. G. COTTRELL

Although oxygen is the commonest of all the chemical elements, making up nearly one-half of that portion of our globe which we have yet penetrated and is found in a perfectly free, that is, chemically uncombined state in the air, simply mixed with about four times its volume of inert nitrogen and very small amounts of other gases, still it has never yet been separated and used in any concentration above that of the atmosphere on a scale at all commensurate with its importance and industrial possibilities.

Not only is it the most common of all the elements, but it enters actively into more processes absolutely vital to human life and industry and to a far greater total tonnage than any other element. We have known of it and its striking properties ever since Priestley first prepared pure oxygen in 1774 and it has ever since been a potent reagent in the hands of the chemist for the special purposes of his laboratory. Still it has taken over a hundred years to bring it forward as a general industrial tool even to the comparatively limited extent it has already reached, while many other elements vastly rarer, inherently more difficult to extract and far less important in their practical applications, have outstripped it in the race.

This situaton, in fact, presents almost an unique anomaly in our technical and economic development and can only be compared to those which ushered in the industrial application of the steam engine and later that of the electric dynamo and motor.

Problem Requires Large-Scale Technical and Scientific Co-operation

The reason that the possibilities and importance of very large scale applications of concentrated oxygen have not heretofore been fully appreciated and developed probably lies in the very magnitude of the project and the diversity of both technical and economic elements involved, rather than in any special difficulty inherent in any one of these individually. In other words, what is most fundamentally needed is the broad comprehensive grasp of the interrelation of these parts of the problem to one another and the ability to find, bring together and hold in active effective co-operation the specialists who can successfully deliver each element of the undertaking, be it technical, administrative or financial.

Turning to the history of commercial oxygen production we find the early industry based generally upon the decomposition of potassium chlorate by heat and the chief market for the gas in the oxyhydrogen or lime light for stereopticon and spectacular purposes with a smaller though important field for medical use. This process of manufacture held the field for practical purposes for many years. Later came the Brinn process substituting barium dioxide for the potassium chlorate and having the significant novel feature of regeneration of the residue of barium monoxide back again the barium dioxide by recombination of oxygen from the air through a change of either pressure or temperature, thus amounting on the whole to the use of barium compounds merely as a carrier to effect the fairly direct separation of oxygen from the air.

The Brinn process came very early, however, into active competition with the production of oxygen by the electrolysis of water, the growth of this latter from about 1895 being a natural consequence of the rapid general development and introduction of electric power into industry in general.

Since in the electrolytic process the determining factor of cost is the power consumption and it was relatively easy from the first to closely approximate in practice the theoretical efficiency possible by this process, the cost of oxygen soon became standardized to the cost of power on the open market and became almost as stable as that of power itself. Furthermore, electrolytic cells were relatively easy to build and operate in units of any size and there were no truly fundamental patents to affect the situation.

The last and most important innovation was the commercial development by Carl Linde, of Munich, and later by Georges Claude, of Paris, of air separation through liquefaction and distillation.

This it was that first vividly opened up to those in position to appreciate it the real vision of the ultimate possibilities for really cheap oxygen. It did not and has not to date, however, brought any significant lowering of the price of oxygen to the ultimate consumer and this is still practically determined as far as this country is concerned by the cost of production of the 25 per cent of our present supply still manufactured through the electrolytic process, plus the cost of bottling, freight on steel cylinders and overhead of the sales and administrative machinery required in such a business.

View of the Present Oxygen Industry

Speaking in round figures, merely to give a birdseye view of the present oxygen industry in relation to what expansion and changes application to major metallurgical operations would mean, the United States present production is about 3,000,000 cu. ft. or say, 130 tons, of oxygen per day, over 95 per cent of which is probably used in torches for cutting and welding purposes.

The one-quarter of this produced by electrolysis comes from several hundred privately owned plants, many of them quite smal, and producing gas only for their owners uses. The remaining three-fourth of the supply comes from about 50 air liquefaction plants owned and operated by the Linde Air Products Co., using the Linde process, and the Air Reduction Co., using, for the most part, the Claude process, but with still some production from the old Hildebrand process. The first of these two companies is the older

* Paper presented at the meeting of Iron & Steel Institute, New York, May 20, 1920.

and has somewhat the larger production. Practically the whole product from both companies is compressed into steel cylinders and sold to the trade.

The largest single installation for air separation ever erected was in connection with the cyanamide nitrogen fixation plant built for the Government at Muscle Shoals, Alabama, during the war. This consists of thirty of the largest size of Claude units. It was bult primarily to secure nitrogen but if operated at full capacity for oxygen would be just about equal in output to this country's total production as given above, and this in turn is just about equal to 1-5 of the amount of oxygen contained in the air blown to one full sized iron blast furnace making approximately 500 tons of iron per day. The United States' average daily production of iron last year was equivalent to that of about 170 such furnaces running every day in the year.

Horsepower Required to Separate Oxygen From Water and From Air

Computed directly from its heat of formation water should theoretically be decomposable with a voltage of 1.48 and a current consumption of 3,032.000 amp. hr. per ton of oxygen; or in round numbers about 6,000 hp. hr., which even at 0.2. per hp. hr. would be $12 per ton of oxygen produced. This represents the energy of chemical combination of the oxygen with the hydrogen in the formation of water and must be supplied from without in the decomposition of the latter.

In the separation of air, on the other hand, there is no chemical combination to overcome. The oxygen and nitrogen simply dilute one another in a simple mixture of the two, and theoretically require no energy expenditure for their mere separation. Due to their mutual dilution, however, their partial pressures in the mixture are only 1-5 atmosphere for the oxygen, and 4-5 atmosphere for the nitrogen and as when finally separated they must both have been compressed up to one atmosphere, we must do at least this much work upon them which amounts, under assumption of isothermal compression to be about 60 hp. hr. per ton of oxygen produced, or only about 1 per cent of that theoretically required by the electrolytic process for producing the same quantity of oxygen, the byproducts being in the one case 3½ tons of nitrogen and in the other 1-8 ton of hydrogen. The values above given are, of course, the purely theoretical limits based on 100 per cent efficiency for every step of the process and piece of the apparatus employed and apply equally to any "reversible" process irrespective of whether it depends upon mechanical, physical or chemical steps. Thus, whether we try to centrifuge the gases apart, or liquefy and distill them, or dissolve them in water under pressure and re-liberate them in fractionated form from solution, or even combine the oxygen with barium oxide and re-liberate it, as in the old Brinn process, the theoretical limiting power requirements are the same and all that interests us from the power standpoint in any cyclic process is the measure in practice of its divergence from reversibility. The criteria of selection among these alternative processes from the side of power consumption must, therefore, be based upon losses of reversibility, i.e., on friction, mechanical leakage, leakage of heat, chemical inertia and losses of thermodynamic potential generally. In practice today the electrolytic process actually reaches an efficiency of from 80 to 85 per cent and probably only very small additional gains on this can be looked for without running up fixed charges proportionally.

Of all the proposed air separation processes, that of air liquefaction and distillation seems not only to have already outstripped all others in the race but to present naturally the most attractive features for large scale development.

Centrifugal Separation of Oxygen From Air

Under very high centrifugal force there is an appreciable tendency for air to stratify into layers of increasing oxygen content toward the periphery of the rotating mass, but the effect is rather small for the magnitude of centrifugal force we can expect to reach safely on a large scale with the strength of materials of construction now available. If we think of this as a continuous process with the air steadily flowing through the apparatus, very special precautions would apparently be necessary to prevent the current from disturbing the process of stratification, as there would be no sharp boundary between layers of different composition as there is between liquid and gas in the liquefaction process. There have been numerous patents taken out on the centrifugal separation of gases, but none of them as yet published seems to meet in comprehensive detail many of these fundamental difficulties, though one would be rash indeed to predict that human ingenuity may not yet produce something of practical value in this field. However oxygen and nitrogen, with a ratio of densities of only 7 to 8, present one of the most unfavorable pairs of gases which could be selected to which to apply the centrifugal method so that, if it ever is worked out in practice, it is apt to find its best competitive field elsewhere, at least at the outset, say for example, in separating hydrogen from water gas where the ratio of densities is from 50 to 100 times as favorable for this method.

Solution of air in water and re-liberation by drop in pressure also effects a concentration of the oxygen, as it is more soluble than the nitrogen. If high concentrations are desired, it becomes necessary as in the case of centrifugal treatment, to repeat the process several times. The process, while simple, would require, however, either very large equipment, or the use of very high pressure, or both, when compared to direct liquefaction.

The ues of a chemical absorbent like the barium oxide of the Brinn process, would be much more practical and attractive if we could find some cheap and stable substance which had much the same properties as the heamoglobin of the blood with respect to the absorbing and liberating of oxygen without waste of energy. Up to date, however, none of the many substances which have been suggested for the purpose have proved to combine these desirable qualities in sufficiently high degree to promise serious competition with the liquefaction process.

Expected Economies in Fractional Separation

The power efficiency in commercial air separation plants already reached on the other hand has probably not much exceeded if indeed it has reached 10 per cent of the theoretical as above given. Here, however, there is a much more hopeful outlook for improvement, as there seems no fundamental reason why we should not multiply the present efficiency several fold by applying the same sort of good intelligent engineering which has brought the steam engine to where it stands today, as the elements of the problems are fundamentally almost identical.

Even with present equipment, the power cost item in air separation is of an order of magnitude comparable with the items of fixed charges, labor and other costs, in all of which further reduction can also reasonably be expected.

In considering items of cost, and especially as concerns installation and power, it is well to bear in mind that if the oxygen plant is included as an integral part when the metallurgical works are first built, a very considerable saving may probably be made through the reduction in size or the entire elimination of other structures, such as stoves, dust catchers, gas mains and the like and that a number of power savings might likewise probably be effected, through the detailed discussion of this belongs more properly under the later head of the metallurgical applications themselves. The development of this work is strictly an engineering project dealing with the handling of large masses of material and must be approached through practice at every point as contrasted with laboratory and experimental methods.

The possible effects to be expected from oxygen enrichment of the air stream must be rather carefully distinguished under several different heads.

Effect on Oxygen on Calorific Intensity

The effect which we are most apt to think of first is simply raising the temperature. This may beneficial and important in some cases, but most of our present metallurgical processes are already standardized to pretty definite temperatures for very good reasons and, if enrichment of the air is applied to them, the chief reasons will probably be other than for a temperature change per se. In fact many temperatures in metallurgical operations are more definitely defined by the character of the charge than is always recognized even by those most familiar with practical operation. This is particularly so in blast furnace operations for, if more heat units are supplied or less taken away the furnace simply runs faster, but the temperature of the metal, and slag, can vary only slightly, as these are nearly through not quite completely determined by the composition and consequent melting point of the charge. The temperature of the coke and gas current in the furnace, especially in its lower position, may, ofcourse, rise very considerably and this in turn slightly superheat the metal and slag as they fall through the lower part of the furnace filled chiefly with coke.

The most important way in which enrichment of blast may essentially influence blast furnace temperatures is indirectly by allowing variations in composition of charge, e.g., making of ferrosilicon directly in the blast furnace. In the case of the open hearth, and specially the converter, the temperature question is a more prominent one, as their operation is not controlled by the melting and automatically flowing away of their charges.

On the other hand, the distribution of heat between the hearth and shaft of the blast furnace is tremendously influenced by enrichment of the blast with oxygen because the diminution of the total amout of gases going up the shaft per unit of carbon burned. It must be remembered that the blast furnace is of all our metallurgical equipment the most complicated from the standpoint of interrelated mechanical and chemical processes going on inside of it and has reached its present state of development by very gradual and conservative steps over a long period. It may therefore not present the most favorable unit on which to commence the regular use of enriched air for standard and continuous operations.

In fact if we ever come to use higly enriched air in making ordinary pig iron the resulting furnace is apt to have very little resemblance to the blast furnace of today. Our experience in the meantime with electrical furnaces should help greatly in this evolution, as the conditions to be fulfilled in an enriched air furnace may reasonably be expected to lie between those of the electric and the present blast furnace.

Attractive Use as Standby

As the blast furnace, however, is the piece of equipment requiring the most continuous and uninterrupted operation, it may be that the enrichment of air for it as an emergency measure in case of trouble such as a threatened freeze-up may prove of considerable importance. Not that freeze-ups really happen with the frequency which one would assume from their prominence in text books and discussions, but that this very infrequency may mean that blast furnace operators have come to work with so safe a margin of conditions to avoid them, that this insurance is costing daily in coke consumption and other requirements or results very much more than we realize, and if one could have a standby source of oxygen for enrichment purposes in case of emergency, even though it were not used at all in normal operations it might permit of safely running on a very much closer margin in the heat allowance of the furnace and making important improvements in its general economy and efficiency.

Another important effect of the enrichment of the air would be the higher calorific value of the blast furnace gas obtained as a byproduct due to elimination of part of its nitrogen. This in turn should mean cheapening of gas engine and other equipment on which it may be used. Furthermore the removal of nitrogen from the blast air will tend to eliminate the necessity for hot blast stoves which at present consume about 1-3 of the total heat value of the gas produced in the furnace.

Oxygen in Open-Hearth

The open-hearth presents some of the most interesting possibilities for the application of oxygen, particularly in those operations where the electric furnace has been the open-hearth's strongest competitor, e.g., where very high temperatures coupled with a reducing atmosphere are desired, as in the elimination of sulphur as calcium sulphide. With an open-hearth using ordinary air in order to reach the highest temperatures now attainable, a complete and carefully balanced combustion of the gases must be secured resulting in a neutral or slightly oxidizing atmosphere, whereas if part at least of the furnace's burden of inert nitrogen could be removed by the use of enriched air the same temperature could be reached while still having a residue of unburnt material in the gas, thus producing a strongly reducing atmosphere. By enriching the air the total volume of gases passing through the furnace per unit of fuel burned and heat produced may be cut down enormously, since in the air there are four volumes of inert nitrogen to every volume of useful oxygen. This would greatly facilitate heat exchange and reduce mechanical difficulties such as dust losses, maintenance and controd of draft and the like, or on the other hand permit of speeding up the furnace and thus increasing its daily output and correspondingly reduce fixed charges and labor per unit of product.

If we carry the application of oxygen back of the open-hearth to the gas producer we may still further extend the same principles and deliver to the furnace more thermal units per unit of primary fuel consumed; beside the actual saving of fuel which this represents, it may in some instances be still more important in cutting down the amount of impurities, especially sulphur, carried into the metal from the fuel. Aside from both of these considerations and viewing the gas producer simply as an isolated unit connection with either heating or power operations, oxygen enrichment of its air supply will permit the use of fuels which could not otherwise be burned in it at all and thus vastly increase our available fuel resources.

Converting Practice

In the matter of possible application to the converter it is perhaps hazardous to speculate in advance of actual experimentation, but once an adequate supply of oxygen is available in the steel works such experimentation will almost inevitably produce useful results, some perhaps from directions we least expect. One of the conditions limiting what metal may go to the converter is the fuel value of the metalloids it contains and in many cases we are paying rather heavily through operating conditions of the blast furnace to put silicon into iron largely for its fuel value later in the converter. A good part of these heat requirements might be removed by abstracting part of the dead load of inert nitrogen from the converting air. Whether such a procedure might lead to a change in our practical classification of bessemer ores is an interesting question, but there seems to be much difference of opinion at present and so many factors enter into the problem that all that can here be done is to merely mention the problem as suggestive of the wide and intensely interesting field of possibilities which cheap oxygen will open up.

In the copper blast furnace running on sulphides with its relatively short shaft and hot top, the advantage of oxygen enrichment is much less open to question than in the case of the iron furnace. Furthermore in all furnace treatments of sulphide ores the problem of disposal of the sulphur in the waste gases is one of ever increasing acuteness as our mining and smelting communities with increase in surrounding settlements meet with more and more exacting conditions with regard to fume and smoke abtement. One of the difficulties in the way of the successful economic treatment of many of these gases for the removal and utilization of the objectionable constituents has been the great dilution of the latter and consequent large volume of inert gases to be handled, a situation which may have quite a bearing on the interest manifested in the problem under discussion. In this connection the use of oxygen may also prove the key to the commercial recovery of sulphur in elementary form from sulphide ores which has been a very elusive and at times a very live problem ever since John Holway's classic work on pyritic smelting in 1878. Also in the roasting of difficulty burning sulphide ores such as those of zinc and very low grade copper ores and tailings preparatory to leaching, the availability of cheap oxygen will be very important especially where the resulting gases are to be further utilized for their sulphur dioxide content either for sulphuric acid manufacture or for other purpose.

Last but perhaps not least may be mentioned the part that oxygen may play in some of the newest developments of general metallurgy, viz., volatilization processes, where in contrast to most of the older metallurgical processes high temperatures may in themselves play an important role. Aside from zinc, cadmium, and mercury it is only lately that we have seriouly concerned ourselves with the primary recovery of metals by volatilizing them from their ores but just as hydrometallurgy after a long and discouraging struggle finally won a foothold through the sucessful application of the cyanide process to gold and silver ores, so now what we might term "gas-metallurgy" seems also struggling for recognition and finding encouraging applications to lead, copper, gold, and silver, to say nothing of potash and phosphorus.

But these last two carry us off again and still further into the field of applied chemistry, where besides the very important group of carbides and nitrides there are a host of other applications for cheap industrial oxygen, even the mention of which the limitations of time and the intended scope of this paper forbid.

A UNIQUE AND NOTEWORTHY RECORD OF SAFETY IN HAZARDOUS EMPLOYMENT.

The case of a night shift of 160 men in an extra-hazardous department who went for four years without a single lost time accident—the most remarkable record of its kind—has just come to the attention of the National Safety Council in the plant of one of its members, the American Steel and Wire Company.

This record was made at the Electric Cable Works, a department of the South Works of the company at Worcester, Mass. On December 31, 1919, the night shift of this department completed its fourth year, operating hazardous processes such as coating cables with molten lead, slitting rubber with series of revolving knives, and rolling heavy cable reels from place to place, without a single lost time accident. These hazards, peculiar to this company, are in addition to the ordinary perils of gears temporarily left unguarded, electric switches, and grinding tools. The fact that this work is all done at night, when workmen are naturally less fit, makes the record truly remarkable.

This safety achievement is attributed by Stephen W. Tener, Director of Safety for the plants of the American Steel and Wire Company, to three things; first, the special efforts that have been made to educate the workmen in safety; second, the fact that the company spared no expense in providing safeguards for dangerous machines or revising dangerous processes;; third, the fact that the foreman of the department was himself thoroughly converted to the Safety idea.

Safety posters are placed regularly on the bulletin boards of this plant and interesting safety meetings are held frequently. George E. Harbour, foreman of the department, has grasped the importance of accident prevention and made the record possible by constantly impressing the importance of care upon the workmen and setting an example by faithfully employing safety methods himselfs.

Casting and Molding Streel Ingots

By EMIL GATHMANN, Baltimore, Md.

(Presented at Lake Superior Meeting, A.I.M.M.E., Aug. 23-28, 1920.)

Steel as it is poured, or teemed, into the mold for forming the ingot may be broadly separated into two divisions; i.e., effervescing or gassy steel, also termed evolution steel, and non-effervescing or killed steel, also termed solution steel.

True unkilled, or effervescing, steel should contain large volumes of gases, which are evolved while the metal is being teemed, or cast from the ladle nozzle into the mold, and while the temperature of the steel is being reduced prior to the solidification or freezing of the steel, the upper portion, or top, of the ingot remaining liquid due to the evolution of gases until an ingot skin of considerable thickness has been formed.

Ingots made of effervescing steel will always contain a large number of blowholes. Such blowholes are not deemed objectionable in various products if they occur well within the interior of the ingot where they will not be subject to oxidation upon the ingot's cooling and subsequent reheating and rolling or forging. Very little top or bottom discard is taken from this type of ingot as piping, or large shrinkage cavities, at the upper portion of the ingot do not usually occur, the difference in volume between the liquid and the solid steel (6 to 10 per cent.) being compensated for by the innumerable blowholes distributed throughout the body of the ingot.

In the usual standard ingot production, when a mold of larger cross-section at the bottom than at the top is used, only one-half, and frequently less than this, of the ingots can be considered as sound, i.e., free from pipe and segregation in the degasified or killed steel and free of so-called surface blowholes and excessive segregation in ingots produced of the unkilled or effervescing steel.

The physical defects are usually at diametrically opposite portions of the ingots in product made of killed and unkilled divisions of steel, respectively; in the semi-killed steel defects may occur at any point of the ingot. The behavior during solidification of the two divisions of steels when teemed into iron molds is radically different, the class of solidification in the killed, or solution steel, being, as so aptly termed by Messrs. Howe and Stoughton, of the pine-tree crystalline growth or so-called landlocking character, and that of the unkilled, or effervescing steel, of the so-called onion-skin class; and in type D, an intermingling of both classes.

Referring, first, to the solidification of an ingot in a metallic mold by means of the pine-tree, or landlocking, type of crystallization, it has been found that to obtain a practically uniform crystalline structure without recurring axial cavities extending deep into the ingot structure below the primary pipe, it is necessary that the cross-section of such ingots be progressively increased from the bottom of the ingot toward its upper portion. In ingots of uniform horizontal cross-action or with a smaller cross-section at the top than at the bottom, bridges of steel crystals will be formed intermittently over the central longitudinal axis of the ingot and shrinkage cavities will occur under such bridges. This fact was not well recognized until quite recently by most makers of solution or killed steel, although advanced and advocated by Dr. H. M. Howe and Bradley Stoughton 15 years ago, and by the writer for the past 10 years. The method of commercially producing ingots with their larger cross-section at the upper portion has now been worked out into a practicable commercial manner suitable for general use without retarding production or materially changing the administrative practice of the steel mill, and is in daily use at a number of high quality mills in this country. The tonnage of big-end-up ingots produced in this country during the year 1919 amounted to approximately 1,000,000 tons gross, including top and bottom cast methods.

Until quite recently, American practice, with some exceptions, was one of tonnage production; and when the buyer specifically insisted upon obtaining really sound, homogeneous steel and was willing to pay a large price therefor, he was usually given the products from the lower half, or possibly third, of the ingot when made of degasified or killed steel, and of the best and cleanest portion (possibly two-thirds) of the ingot when made of open, unkilled or effervescing steel. The remainder of the ingot was sold to customers whose requirements for quality were not as strict nor as high, or it was remelted.

Solution steel should, if the specifications permit, have a silicon content of at least 0.20 per cent., as otherwise a large amount of special deoxidizer (aluminum, titanium, or the like) must be used in the ladle and possibly in the mold in order to thoroughly degasify the steel. In effervescing steel, the silicon content should be kept as low as possible and little or no special deoxidizer used in the ladle or mold, as otherwise a steel of division D will result, having both blowholes and shrinkage cavity, or pipe, or undertermined location and size.

The best results, as to freedom from surface blowholes, snakes, etc., in evolution steels are obtained when the ingots are bottom cast. This is the practice in the steel plants of our large plate mills, bottom-casting methods, however, are more expensive than top casting, a loss of approximately 5 per cent. being due to runners and feed head.

Similar results as to deep seating of blowholes and freedom from snakes have been obtained in this division B steel by means of what may be termed top-bottom casting; that is, employing a special teeming or pouring nozzle whereby the pressure and velocity of liquid steel as it enters the mold is greatly reduced without, however, reducing the quantity or volume per minute of steel teemed. During the war, a variety of apparatus was quite successfully used by various steel producers to accomplish this end. Extensive tests are being made to develop this method of top-bottom teeming further, by reducing the high velocity of the hot stream as it leaves the nozzle of the ladle. Each per cent. increase in sound, usable ingot will effect a net annual saving of over 500,000 tons of coal, coke, or equivalent fuel to the steel industry of our country. The total annual monetary saving per each per cent. increase in finished product will amount to approximately $10,000,000, without considering the manifest advantages and benefits to the public in being able to obtain a better, more uniform product that is capable of giving a longer service for initial investment.

CUTTING OILS ARE CAUSE OF INFECTION.

Frequenty of infection due to the use of cutting oils in machine-working establishments, according to the report of Lewis T. Bryant, New Jersey state commissioner of labor, caused the bureau to refer this subject to the consulting chemist of the department of labor, who submitted the following report on this subject:

"The cutting oils used in the metal industries can be divided into two classes:

"First—Straight cutting oils which are not soluble in water and which might be called acid cutting oils. They usually consist of a mixture of about 30 per cent lard oil and 70 per cent mineral oil.

"Second—Soluble cutting oils which may also be called alkaline cutting oils......they consist of a mixture of soap and water with a sdight addition of alcohol in which ingredients mineral oil is dissolved.

"A solution of mineral oil in soap has the peculiarity on mixing with water to keep the oil suspended in the water in a very finely divided state, or, in other words, emulsify it. This emulsified mixture is then used a a lubricant or cutting oil.

"The ingredients from which the soap is prepared are usually either rosin oil or some fatty acid or mixtures of both. The alkaline base for the soap is usually soda or a mixture of soda and potash. The amount of alcohol used is very slight.

"It has been my experience that the skin troubles arising from the use of cutting oils happen mostly where soluble oil is employed. However, even where insoluble cutting oil is used, cases of erruption are not infrequent, and it is therefore obvious that the cause of the trouble must be a substance which is present both in the soluble and insoluble compound. This, of course, is the mineral oil.

"This view of the matter is strengthened by the fact that also in the mineral oil industry a great deal of trouble is experienced with certain mineral distillates. The trouble there is well known under the name of the paraffine itch. The mineral employed in the cutting oil is usually a wool stock or No. 28 paraffine oil. These oils are comparatively unstable and readily change into compound of an acid nature which are water soluble.

"When the so-called soluble oil is mixed with water, the oil remains extremely finely divided and partly dissolved in the watery solution. It is obvious that it enters the tissues much easier and much farther than a straight oil and this is the reason why there is less trouble experienced with insoluble cutting oils than with the soluble ones. So far, it has been impossible to isolate pathogenic bacteria from any of the cutting oils.

"It must not be forgotten that since the war started the various mineral oils have been refined to a lesser degree and contain nowadays more impurities than formerly, a fact which may have something to do with this trouble at the present time. Of course, the high prices of all petroleum products have naturally been an inducement for the manufacturer to substitute cheaper and less refined goods.

"I have a strong suspicion that persons suffering from certain blood diseases are very easily affected by these compounds. A friend of mine has tried hard to induce a number of patients to submit to the Wassermann test, but so far has been unable to prevail on them to do so.

"Remedies: Whenever possible, insoluble cutting oils should be used and the latter should be sterilized by heating to about 190 degrees Fahr. I know of at least one large company that does this and claims to have mastered the difficulty.

"Where it is necessary to employ soluble cutting oils the buyer should insist that the compound be made with a highly refined mineral oil and that a slight percentage of either carbolic or a similar acid be added. I know of a few cases where this has been tried with success."

CANADA'S STEEL TARIFF

In Relation to Exports from the United States—Proposed Downward Revision

Washington, Aug. 24.—Plans for the revision of the Canadian tariff laws have a particular interest for the American iron and steel industrry. No other section of the Canadian tariff statutes is so comprehensive as the one which covers importation of iron and steel. More than 100 individual paragraphs are devoted to this industry. The law, as it stands, was carefully written to protect Canadian industries. If Canada did not, the duty was low or probably removed entirely. The appointment of the Canadian tariff commission, which has announced its program for this fall's work revision, was largely the result of pressure from the liberal elements who want revision downward. Much of it comes from the rural districts where the farmers complained of the high prices of agricultural machinery.

The city dwellers who are not participants in a protected industry declare that the tariff was responsible for of the high cost of living. On the other hand the Canadian industrial representatives insisted that a reduction of the tariff would leave them defenseless against American industry. They pointed out the large number of infant industries which were established during the war and which they claim could not exist if the tariff walls were to be weakened. Another argument they used with considerable effect was the increasing number of branch factories which were being established in Canada by American manufacturers.

The question of a general tariff revision in Canada also includes an important item of "imperial preference." The present schedules include varying degrees of reduction in favor of other members of the British Empire. It does not seem likely, however, that these percentages will be increased, as Canada in the past has not been enthusiastically in favor of this preference.

In the fiscal year ending June 30, 1920, the United States exported to Canada $890,135,023 worth of manufactured and other products, against $810,745,160 in the preceding year. These figures were almost double the imports from that country. In 1920 the imports from Canada were $537,377,381, and in 1919 they were $468,954,818. Only one country was a greater customer of the United States in 1920, namely, England. In 1919 France bought more than Canada, but receded to third place in 1920.

The Bureau of Foreign and Domestic Commerce has not complete itemization of all the exports of iron and steel to Canada during 1920. The more important items, however, are of considerable interest in showing

the fluctuations in values of some of the larger totals of this commerce. The following table contains the values of iron and steel exports to Canada for the fiscal years ended June 30, 1919 and 1920, as far as such exports have been compiled:

Iron and Steel Exports to Canada

	Fiscal Year 1919	Fiscal Year 1920
Pig iron	$ 3,437,416	$ 1,224,184
Billets, ingots and blooms	13,030,095	385,946
Locomotives	517,321	587,817
Metal-working machinery	4,581,495	5,676,288
Sewing machines	550,134	999,204
Typewriting machines	900,223	1,254,659
Wire nails	197,838	59,568
Wrought pipes and fittings	1,165,209	1,250,828
Cast iron pipes and fittings	704,382	840,947
Steel rails	2,601,709	503,603
Galvanized sheets and plates	1,344,747	2,928,022
Steel plates	15,825,948	11,621,928
Steel sheets	5,248,277	5,259,521
Structural iron and steel	7,656,738	5,989,174
Tin and terne plates and taggers tin	9,082,355	8,274,355
Barbed wire	1,293,612	2,256,532
All other wire	2,706,708	2,367,018
Mowers and reapers	302,807	433,086
Plows and cultivators	1,463,072	1,969,949
Commercial automobiles	2,456,455	4,422,649
Passengers automobiles	5,758,609	12,615,290
Freight cars	801,172	401,932

COPPER IN STEEL TIE PLATES LESSENS CORROSION.

The New York Central lines have conducted a series of tests under the direction of J. V. Neubert, engineer maintenance of way, Eastern lines, to determine the relative loss of metal in tie plates of various compositions, including those containing a small percentage of copper. The length of time over which the tests were conducted varied from two years to a maximum of six years, and some of the tests are still in progress. In all cases the maximum corrosion developed on the bottom or under side of the plates, contrary to the generally accepted theory of most engineers and maintenance of way men that the maximum corrosion takes place on top of exposed portion. The results, as given below, are detailed by the "Railway Age."

The percentage of copper in the plates containing that metal ranged between 0.25 per cent as a minimum and 0.5 per cent as a maximum, the plates so treated being rolled otherwise according to the standards of the New York Central. The copper-treated plates so obtained were subjected to the same tests as the other plates. An exposed test on a number of steel tie plates rolled from mild Bessemer steel containing 0.25 per cent copper and a number rolled according to the same specifications without the copper content showed an average loss of 8.88 per cent for untreated plates and only 1.46 per cent for the treated plates.

A second exposed test was made which covered a larger number of tie plates rolled from metals of various compositions. The plates used in this instance were cleaned and then exposed on the roof of a building at Hoboken, N.J., where the action of the

salt air of New York bay could be studied. Investigation showed that the loss on the copper plates varied from 0.46 to 0.72 per cent, with an average of 0.56 per cent.

In comparing the data so obtained the nearest approach to the results reported from the copper-treated plates was a loss of 0.59 per cent for high carbon open-hearth steel, too hard to punch. The pure iron plate came next, with 1.17 per cent, and then the high-carbon Bessemer plate, with 1.77 per cent, the latter also being too hard to punch. The remainder, which were standard steel tie plates, varied from 4.70 per cent to 6.60 per cent, showing in the common or regularly accepted tie plates eight to ten times the loss for the special copper-treated ones.

This addition of copper naturally results in a slightly higher first cost, but the increase over regular prices will be but $2 to $3 a ton, depending upon the size of the order and other relative conditions. As a result of these experiments the New York Central has placed an order for 650,000 tie plates, or 4,000 tons, to be rolled according to the railroad's standard specifications, with the addition of 0.25 per cent of copper.—"Iron Age."

THE KEYSTONE OF INDUSTRY.

From an advertisement of the Australian Iron and Steel Industry in the "Industrial Australian and Mining Standard".

"Unless the Iron and Steel Industry is established "on a firmer basis, there can be no stability in the "dependent industries, no real National Safety, no "permanent National Progress."

NEW SHEET MILL USES POWDERED COAL

At the new sheet mill of Follansbee Bros. Co., Toronto, Ohio, the furnaces for the sheet mill will be fired with powdered coal.

For transporting the pulverized fuel from the milling plant to the furnace bins, the Quigley Air Transport System has been adopted. A standard blowing unit of five tons capacity consisting of pulverized fuel bin, blow tank and scales and which is capable of transporting ten tons of pulverized coal per hour, will be installed. The total distance for transporting fuel is approximately 1,700 ft.

SILICA PRODUCTS COMPANY TO OPERATE IN CAPE BRETON ISLAND.

For some years a proposal has been mooted to develop the large areas of silica rock which exist in the neighbourhood of Orangedale and Whycocomagh, Cape Breton Island, and it is understood that Canadian letters of incorporation are being sought for a company to be known as the Empire Silica Company. The promoter of the enterprise is Major Burton of New York who is said to have associated with him a number of reputable United States capitalists.

The new company proposes to employ in full operation some one thousand workmen, and contemplates the manufacture of firebrick, cement and lime products.

COKE DISPOSAL

The growth of the by-product coke industry independent of the iron and steel industry and the prospects for developing it primarily, as a source of gas without necessity for relying on the needs of blast furnaces, depend almost entirely on the question of coke disposal. The extension of the domestic coke market is of great importance in this connection, and much progress has recently been made in this direction. The situation bears close relation to the condition of anthracite coal supply which is yearly becoming poorer in quality and more inadequate in amount. Just as the availability of natural gas has accustomed millions of American people to the use of gas fuel for domestic purposes, so the wholesale use of anthracite coal as domestic fuel has paved the way to introduction and substitution of coke.—Gas Age.

EDITORIAL

Stationary Position of Pig Iron and Steel Refining Capacity in Canada

As was noted in our last issue, the statistics of pig-iron production in Canada disclose no enlargement of blast-furnace capacity during the past ten years.

The increase in the production of steel ingots and castings which resulted from the war was obtained by using up cold stock, scrap and shell turnings, and by the employment of electric furnaces; but, so far as regards blast-furnaces (the number of which in operation is the surest index to the fundamental soundness of the steel industry in any selected locality) Canada is not better off than she was ten years ago.

A similar observation might be made regarding open-hearth and other refining furnaces—other than electric furnaces—so that it is correct to state that neither in the manufacture of iron, or in the facilities for its refinement to steel, is Canada measurably better provided than before the war.

The following table shows pig-iron production in Canada from 1910 to 1919 inclusive, as compiled by the Mines Branch:

	Short Tons
1910	800,797
1911	917,535
1912	1,014,587
1913	1,128,967
1914	783,164
1915	913,775
1916	1,169,257
1917	1,170,480
1918	1,195,551
1919	917,781
1920 (est.)	1,000,000

The production of steel during the same period was as shown under:

	Steel Ingots		Steel Castings		Total Steel
	Open-Hearth and Bessemer	Electric	Open-Hearth and Bessemer	Electric	Ingots and Castings
1910	803,600		18,085	599	822,284
1911	861,493		20,163	740	882,396
1912	923,280		31,845	2,556	957,681
1913	1,126,750		39,217	3,026	1,168,993
1914	811,567		15,315	1,759	828,641
1915	981,859	7,970	28,384	2,683	1,020,896
1916	1,378,803	18,900	23,496	7,050	1,428,249
1917	1,643,085	49,206	43,630	10,813	1,745,734
1918	1,684,317	115,854	62,017	11,520	1,873,708
1919	984,298	8,741	30,542	6,761	1,030,342

A comparison between pig-iron production and steel production will show that—apart from the war period—the situation in 1919, and at this time, approximates to that of ten years ago.

The Canadian steel companies have improved their plant equipment by the addition of new coke-ovens and rolling mills—for structural shapes and plates—and have strengthened their position by acquiring coal areas, and by additions to cash and quick assets, but they have not enlarged their actual productive capacity, neither in coal or pig-iron.

A study of the imports of iron and steel into Canada will further show that the stationary condition of the primary branches of the steel trade in Canada is not due to lack of domestic demand, for the importations of iron and steel from the United States never were higher than during recent years, and in the trade returns of the Summer just ended

the most notable increases in imports have occurred in the items of iron and steel.

In the year 1913, after the steel companies had experienced some years without the aid of the steel bounties, and were faced with the trade depression of that year, their financial position was anything but enviable, and the numerous congratulatory comparisons that are encountered in the financial papers, when they comment on the present improved status of the Canadian steel enterprises, should be mitigated by consideration of the worryingly insecure position of the steel companies in 1913, and of the coming testing-time, the beginnings of which are even now discernible in steel circles.

What is the conclusion that these considerations lead to? It is that the tariff protection given to the production of pig-iron and steel in Canada has been very nicely calculated, so nicely in fact as to amount to insecurity in effect. During the period that has intervened between the expiry of the steel bounties and the present time the tariff protection has never been adequate to thoroughly offset the superior position of the United States steel companies in their possession of cheaper raw materials, bessemer ores, immensely greater financial resources, cheaper and more suitable coal supply, and a more numerous and adaptable labor supply.

The stimulus given to the production of pig-iron and steel by the war has served to demonstrate first of all the value of the industry as a means of national defence and self-reliance, and has also served to create much-needed financial reserves, but the war was, after all, a temporary interjection into the normal tenor of business, and it should not be allowed to disguise the fact that before the war, and now that its effects are fading, the basic part of our metal-working industries showed, and is showing, a stationary tendency.

Iron and Steel Practice as Influenced by Local Conditions

Professor Albert Sauveur, speaking before the American Society for Steel Treating—the new name of a consolidation of organizations of steel technicians—draws attention to the fact that the contribution of citizens of the United States to iron and steel metallurgy has been marked more by improvements in the mechanical arts and the handling of large tonnages of material than by basic contributions to the science of steel manufacture. This is not an unnatural development in view of the comparatively recent date of the dominance of the United States in the steel markets, and it is an outgrowth of that lavish provision of nature's gifts the white man found when he came to the United States in large numbers. The almost bewildering abundance of coal, iron-ores, timber and agricultural lands led the American to think in terms of millions where the European thought in terms of hundreds. The natural wealth of the United States, combined with a numerical population that was not irked by the lack of elbow-room, conduced more to action than to scientific thought. The growth of millionaires in the United States, "oil kings", "coal kings" and their like, has not been so much an indication of transcendent mental ability in the men who have achieved this doubtful eminence, as an outgrowth of the superlative wealth of the United States combined with a relatively small density of population.

A change is coming over the outlook of the United States. Its unparalleled natural resources, although still of portentous extent, are not what they were, and the thoughts of Americans are being perforce directed along similar lines of economy to those that their European brethren have been compelled to follow for many centuries.

It is probable that when the citizens of the United States really turn their thoughts towards scientific research in methods of more complete utilization of natural products they will quickly excel, even as they have done in the comparatively late adoption of the "safety-first" and "industrial welfare" movements. Here, the United States followed, but now it leads far in advance.

The financial endowment of scientific institutions, and centres of culture, is proceeding today in the United States on a scale that will soon leave far behind all the ancient endowments of European civilization. It has become a cult among the rich men of the United States, embarrassed by a wealth that they feel is the result of a condition, and not of personal intrinsic worth, to endow foundations and centres of culture and philanthropy, much as the remorseful kings and barons of the Middle Ages did in Europe, for the assoilment of their souls. The result of these numerous and richly endowed creations of individual beneficence is going to exert a profound influence on American evolution.

To Canadians, whose bonds of connection with Britain are more recent and closer than those of our friends to the south, and whose national strain is not so diluted by diverse national origins, the part that has been played by British scientists in metallurgcal achievements, as noted by Prof. Sauveur, is read with pleasure. The names of Huntsman, Bessemer, Abram Darby, Dud Dudley, Mushet, Sorby, Cort, Gilchrist, Roberts-Austen, Arnold and Stead, each recall a distinct step in the advance of iron and steel practice.

In Canada, the working out of our own peculiar problems, which, in the matter of iron and steel do not arise out of a super-abundance of natural pro-

vision, but the reverse, will doubtless develop a national technique, as our lignite problem is already doing.

As an instance of this, we are pleased to be able to call attention to Mr. J. W. Moffatt's experiments upon a working scale looking towards the commercial utilization of our native lean iron-ores by a process which uses coarse, or fuel heat, in a preliminary metallizing process, and uses electric heat for the further high-temperature refinement to steel. This process, as will be noted by reference to Dr. Stansfield's note in the February issue, follows the idea which Dr. Stansfield has been working out, aided by financial assistance from the Metallurgical Committee of the Advisory Research Council.

Dr. Stansfield concluded his note by remarking that the results obtained in his experiments at McGill University, added to information received from others working along similar lines, had convinced him "that commercial success may be expected, and "it appears that a means will thus be found for "utilizing many Canadian ores with the aid of water-"power and low-grade fuel, and that material expan-"sion of the Canadian iron and steel industry should "ultimately result from this development."

It does not appear in excess of the facts, therefore, to remark that metallurgical history is even now being made in Canada, and that out of our necessity will arise Canadian invention and a distinctive local technique.

The Unreality of the Tariff Discussion

It is impossible to avoid the conviction that there is a good deal of unreality and insincerity about both the attack and the defence of the protective tariff in Canada.

It is ridiculously evident that there is no fundamental difference in actuality in the attitude of the several political parties towards the tariff, although ostensibly there is much wordy difference. The whole country is convinced apparently that the tariff, both for protection of home industries, and for internal revenue, must exist. The difference of opinion seems to be over modifications of the schedule of percentages, which is very proper matter for consideration of a permanent tariff commission, but is too small and finicky a matter to create political excitement such as marks the fight over a principle, or over a radical change in policy.

Those who favor protective tariff can evidence the unparalleled prosperity of Canada, and the unprecedented rate of transference of United States enterprises to Canada. Whether this is due to the protective policy Canada has followed is a matter of opinion, of affirmation and belief, but it is not a mathematically demonstrable fact. Those who favor free-trade, in order to prove their theories, would be required to carry out an experiment, which their opponents say would upset our national apple-cart. The experiment would bear some analogy to the suggestion in the fable of the mice and the cat. No one will desire to be chosen to bell the cat. Free-trade in Canada is, and has been throughout all the important part of the country's history, a mere academic political theory. Theories have proved dreadfully dangerous to the world of late, and their attempted translation into fact has made widows and orphans and upset the world's peace as never before in history.

It is impossible to conceive that those who favor free-trade in Canada desire disaster to follow, but even the most intractable free-trader cannot avoid an uneasy consciousness that Canada is doing very well, too well in fact to risk the tentative trying out of a theory, which might, and also might not, improve matters.

There is also the stubborn fact that Canada, because she has imported more than she has exported, has to submit to a discount of approximately one-eighth on her dollar exchange. This fact makes it extremely hard for any lover of his country to advocate making it still easier and more attractive for the United States to increase her imports into Canada. No one has yet attemptetd to argue that abolition of protective duties would encourage greater exports from Canada, seeing that virtually every worth-while export of Canada is admitted duty free into its outside markets.

There is another, and not inconsiderable consideration, namely, the revenue-raising side of our import tariffs. The country certainly needs the money, or it would scarcely have required to offer its citizens five and a half percent interest on a dead-sure investment. There are certain things we import from the United States at this time that we must have anyway, and at any price, coal for example, on which our government might just as well collect a revenue tariff as see the amount represented absorbed by the United States producer and middlemen, as has been the case with the fifteen cents reduction on bituminous coal made at the last tariff revision. The effect of this reduction has merely been to lose the Government 15 cents a ton on all imported bituminous coal, and no benefit has accrued to the consumer. We doubt if the average consumer ever heard about it.

A well-known New York financial bulletin in a recent issue displays a graph showing the rising line of

United States imports into Canada, and the falling line of Canadian imports into the United States, and makes the following comment:

"A suggestion that Canada has been buying too "much from the United States is found in this diagram. "These large exports into Canada have been respon- "sible for the depreciation of Canadian exchange, "and have caused certain Canadian politicians to "declare in favor of further increases in the Can- "adian protective tariff, the argument being that "financial conditions in Canada will not be restored "to normal until purchases of goods in the United "States are cut down. A prohibitive tariff would "lead to a stoppage of American goods and cause "a further flow of American capital into Canada to "establish branch factories. This would improve Can- "adian exchange by producing a smaller flow of "trade remittances from Canada to the United States, "and an increased flow of investment remittances "to Canada. But an abnormal tariff would also in- "volve excessive prices for goods now imported by "Canada, and for that reason, politically considered, "the question has two sides."

All of which is fairly elementary, but it will be noticed that a policy of tariff reduction on the part of the Canadian government is not suggested, as whatever else our southern neighbors may think about us, they have not hitherto regarded Canadians as lacking in common sense.

The obvious undesirability of a policy that would encourage increase in the rate of imports into Canada, and would at the same time offer no hope of increase in exports from Canada, is so patent that it explains the indifference of the average man towards the tariff discussion.

He cannot get excited over a battle of theories, when he knows full well that the course of action which the combatants must pursue, irrespective of who proves victor, is predestined by the iron facts of our discounted dollar and our debit trade balances.

Selection of Works Coal by the Microscope

The microscopic examination of thin coal sections is commencing to yield useful results. Early observers, as Lomax in Lancashire, laid the basis for empirical deductions by examining and tabulating the appearance revealed by the microscope; and eventually Lomax was able to build up sections disclosing the nature of coal seams from floor to roof, which when correlated with accepted theories of the formation of coal seams from forest growths, annually deposited over periods of inconceivable vastness, and chemical investigations of the main constituents of coal, as disclosed by the microscope, have thrown light upon problems connected with the suitability of selected coals for industrial uses, that ultimate chemical analyses of coal did not explain.

For example, two coals of similar appearance and identical chemical analysis will act dissimilarly, say in the coking process.

A paper read before the Iron and Steel Institute at the Autumn Meeting (Sept. 21-22) by Mr. A. L. Booth of Manchester intimates that Messrs. Armstrong, Whitworth & Co. have used the microscope in the selection of some 250,000 tons of coal used annually for different purposes. It was found that coals that had for years been found satisfactory for certain purposes, when examined microscopally, had certain characterisics of color and structure which made them distinguishable as a type, and that coals selected because of recognizable type resemblances—irrespective of analysis—were found satisfactory upon trial.

A series of colored plates (which typographical limitations prevent reproduction of) accompany Mr. Booth's paper, and show clearly three main types of coal, namely humic, spore and cannel coals.

There is now fairly general agreement among investigators of coal substance that the original vegetable component of coal has much more to do with its behavior in the various processes of industrial use, than the subsequent forces of heat, rock pressure or geological age, and it is the nature of this original substance that the microscope is eminently fitted to disclose.

Mr. Booth states that the miscroscope not only helps in the selection of coals, "but in some cases is of use in deciding whether or no it will pay to wash them, and will explain why an apparently good, clean coal has, for instance, a high ash content. Washing may be quite useless in such a case."

The presence of disseminated free sulphur, of infinitesimal fineness, is also detectable by the microscope, as has been shown by Dr. Rheinhardt Theissen.

Coal sections from representative Nova Scotia bituminous seams indicate by their characteristic reddish tinge and abundance of cuticle matter that they belong to the group of "humic" coals, which are stated by Mr. Booth to coke well, and to give a good hot fire without too long a flame. This describes accurately the behavior of these Nova Scotia coals.

Other qualities that are determinable from microscopic examination are tendency of a given coal to yield an inflammable dust, or liability of coals to spontaneous combustion.*

Coal from a given seam will show generally uniform characteristics, over large tracts, which points

* See Lomax, Trans. Inst. Min. Eng., Vol. XLVI, Pt. IV.

to the employment of microscopical examination to determine the correlation of seams separated by folds in the stata, or areas of denudation.

In deciding upon the suitability of seams of unknown qualities, and in formulating opinions on such limited evidence of suitability as may be obtainable say from a diamond-drill core, the combined use of the microscope, with chemical analysis, for comparison with sections of well-known coals, suggests itself.

The microscopic study of coals sections is a younger and in some respects, a more difficult art, than the related sciences of metallography and petrography, but it bids fair to yield equally important results, and to become as indispensable a part of industrial laboratory equipment, in the allied steel and coal industries more particularly.

The Association of Workmen's Compensation Boards

The Association of Workmen's Compensation Boards in Canada is becoming an important body. Originally planned to exchange information, statistics and other data interesting to men engaged in the administration of workmen's compensation in the various provinces of Canada, this association is rapidly developing into a national advisory council in matters pertaining to occupational accidents.

Co-ordination of statistics, comparison of the incidence of accidents, exchange of views of accident prevention, on rates of compensation, medical aid, pension funds, and many other matters that might be mentioned, provide useful and proper activities for conference by the representatives of provincial compensation boards, but, according to newspaper reports, the Association has extended its deliberations to the passing of resolutions advocating changes in workmen's compensation laws that amount to advice to the various provincial legislatures interested. Such resolutions are within the proper province of a meeting of citizens, but we think they are distinctly improper activities for an association of officials charged with the administration of workmen's compensation laws that differ in every province of Canada.

For example, a newspaper report states the opinion of the delegates to the Association at one session to have been that workmen's compensation should be extended to every workman, and not limited in its application to any set of industries. Another resolution passed was that accident prevention work should be placed under the compensation boards in each province, following the lead of some provinces that have already adopted this plan. There is much to be said for these opinions of the Association, and we would not wish to attack the merits of either proposal, but we conceive it to be distinctly outside the function of provincial officers, appointed to administer a statutory office, to advise the country at large as to what should be the trend of workmen's compensation legislation. As private members of an accountants' society, medical association, or bar society, such opinions might be properly advanced over the names of their advocates, but they are distinctly not the business of an "association of Workmen's Compensation Boards in Canada."

Shipbuilding in Canada

There is observable in Canada a tendency for steel shipbuilding to concentrate in fewer hands, and the closing down of several yards indicates that those yards which are most likely to survive as permanent enterprises are those associated with powerful allied interests, and situated advantageously with regard to delivery of steel products, engines and boilers, and close to a resident population of industrial workers.

Following the closing down of the Dominion Shipbuilding Company's yard at Toronto, there is announced the permanent closing down of the British American Shipbuilding Company's plant at Welland, to take place after the launching of the Canadian "Squatter". The number of men employed in this yard has been gradually diminished, and when work was as its busiest 570 men were employed.

The Foundation Company's yards at Vancouver—which built wooden vessels—has been dismantled. At one time 4,000 men were employed by this Company. The equipment has been disposed of in large part to the steel-shipbuilding companies in Vancouver and Victoria.

The Harbor Marine Co. of Victoria, following the launching of the "Canadian Traveller" is laying off the greater part of its employees, but following the completion of the "Canadian Winner" it is expected that shipbuilding at this Victoria yard will close.

The yards that will continue to build steel ships will include those associated with the British Empire Steel Corporation in eastern Canada, Canadian Vickers of Montreal, the Prince Rupert Dry Dock and Engineering Co., the Coughlan and Wallace yards at Vancouver.

That there would be some elimination of the shipyards, not possessing the necessary elements of permanence, following the passing of the urgent situation occasioned by the war, was expected by everyone acquainted with the competition that exists in steel shipbuilding; but it is to be hoped that the decline in

the industry in Canada will not be allowed to proceed too far. No doubt the Canadian Government has a policy on this matter, and it has set out to create and perpetuate in Canada both a mercantile marine fleet and the means to enlarge it.

We ventured to remark in our last issue that Canadian shipbuilders would have to ask assistance "to bridge over a period of trial that is possibly awaiting shipbuilding." It looks as though the period of testing were here, and, in view of the record of the Government up to this time, we believe it will continue a policy of aid to steel shipbuilding in Canada because it is the body most vitally interested.

BALDWIN'S LIMITED, TORONTO.

The opening of the first unit of the tin-plate rolling-mill of Baldwin's Limited at Ashbridge's Bay, Toronto is the kind of event that has in recent years occurred with too little frequency in Canada. We have seen a large scale projection of United States' corporations into Canada, particularly into that part of central Canada which points down like a finger into the territory of the United States, but the extension of British enterprises has been all too limited. On the Atlantic Coast, and singularly enough on the Pacific Coast, which, though the statement may sound paradoxical, has closer correspondences to Britain than Ontario has, the visible connection between Canadian interests and British interests in industrial respects has been more marked, as witness such representative branch enterprises as Vickers, Armstrong-Whitworth, and mooted future connections between the Atlantic and Pacific coast coal and iron industries and British steel-masters. In central Canada, however, there has, from merely geographical reasons, been a much greater extension of the sphere of United States business enterprise than of Old Country projects. Therefore the translation of a portion of the great business of Baldwin's Limited to Toronto is an event of much significance, and we believe, of much happy augury.

Mr. Nathaniel Thomas, the Mill Superintendent, at the opening of the first mill-unit said that in the United States the tin-plate industry was almost entirely manned by European labor, and expressed a desire, which will find general echo in Canada, that such a development would not take place in Toronto.

The migration of a number of Welsh workers to Toronto from the home works is a reminder that, notwithstanding the special adaptation of Welshmen to many Canadian industries, such as rock-mining, coal-mining and steel-products industries, the emigration from Wales to Canada has always been proportionately less than it has been to the United States, where, in some localities, they form a preponderating and deciding element in the population. This preference for the United States by the people of Wales has been distinctly a loss to Canada, for they take abroad with them a racial culture that has many excellences in music, art, literature and industrial achievement, and, while the Welshman's racial tradition and his hold upon his language and the past is the firmest of any branch of the Celtic peoples, he is not a disruptive force in the federation of the British peoples. "Canada Nhi. A Nhi I Canada" ("Canada for us, and us for Canada") is said to be the slogan of the Welsh employees of Baldwin's Limited, and a very good one.

THE PROVISION OF HOUSING BY MINES AND STEEL WORKS.

A statement which has attained such wide publicity as to appear in a Toronto newspaper is attributed to an organizer of the A. F. of L. regarding housing conditions in the Cape Breton colliery districts. This observer's comments contain sufficient truth to give them sting, but he goes too far when he says that conditions are far worse in the mining districts of Cape Breton than in the worst slums of the great cities of America, San Francisco's notorious Chinatown not excepted. The veracity of this much travelled critic is shadowed by a further remark to the effect that after studying the development of the British Empire Steel Corporation he believes it will attempt to import coolie labor into Canada. As the British Empire Steel Corporation has not yet any corporate organization, having no designated officers, it is difficult to see how such an intention can be imputed. The gratuitous assumption reveals a bias that would make impartial criticism from this observer rather difficult.

Yet it is nevertheless true that some undesirable community conditions have concentrated themselves into one or two districts in the vicinity of Sydney. It is difficult to assess the blame, but the chief causes have been those which have usually brought about slum areas in Canada, and elsewhere. Lack of any system of town planning, inexcusable laxity of building regulations, property speculation, non-Canadian elements of population, transplanted habits of dirt and congestion from European countries, and the ignorance of the immigrant, may be mentioned.

Circumstances have forced the industrial companies to become large providers of housing accommodation, and the ideas of these companies have necessarily not advanced faster than the conventions of the times and population in which they evolved. The Dominion Coal Company, for example, was founded upon the financial ruins of a number of independent smaller companies which commenced their chequered careers anywhere between 1857 and 1893, and the new consolidation inherited the plants and housing provision of earlier, but not better days. The style of housing provided in the successive stages of the progress and ex-

pansion of the Dominion Coal Company has improved, and the company's houses at the newer collieries are eagerly sought after, being better houses at lower rentals than are elsewhere obtainable.

The Dominion Steel Company in Sydney is not a large landlord, and its houses also are sought as a favor.

At Sydney Mines, a very large proportion of the mine workers own their own houses, and slum conditions do not exist in this colliery town. It is also true that a large number of the steel workers and coal miners in the Sydney District are their own landlords.

The provision of houses for employees has been to the coal and steel companies of Nova Scotia a necessary thing, but also an unprofitable thing, a source of much anxiety. Willy-nilly, the Nova Scotia companies—and this is a statement generally true of mining companies in a new country—have been compelled to become landlords, shopkeepers, provider of all public utilities and communal requirements and of transportation. In doing this they have naturally combined the vulnerability and possible points of attack of this combination of much berated responsibilities.

The slum areas, which undoubtedly exist, have evolved as a parasitical growth, and enquiry would reveal that the worst rack-renter and the genderer of undesirable housing conditions is the former immigrant, now grown rich, who takes advantage of the ignorance and trustfulness of his newly arrived compatriots, and sees no hideousness in slums that are an offence to our Canadian ideas. Some of these men, by their control of sources of illegal liquor supply, and their financial grip upon their fellows, achieved through the supply of housing, food, liquor and every possible source of profit, can exercise a sinister influence on labor matters, nor are they lightly offended by either corporation or municipal officers.

It is this position of vulnerability which accompanies the function of general fatherhood of the community, and the impotence of municipalities and corporations, to prevent the growth of parasitical slum areas and their concentrated evils, that has driven mining corporations in Canada to build "closed" towns, and to oppose municipal incorporation. Labor organizations have imputed other motives, but wrongly so.

A Social Survey was undertaken some years ago of a well-known section of the City of Sydney. The existing conditions were properly criticized, but the blame was laid upon the industrial companies. The truth is that these same companies have provided the most substantial part of the decent housing accommodation of the industrial centres of Cape Breton, and they probably contemplate with something like consternation the expenditure on housing that will be necessary, at existing building costs, to accommodate all the additional population that mooted expansion of operations will require.

The foregoing gives point to a statement that Mr. Adams, of the Town Planning Division of the Commission of Conservation, is to be asked to advise the Dominion Coal Company, through its newly created Department of Industrial Relations, regarding the plan of a town to serve the workers of a new colliery near Glace Bay. This, at any rate, shows a willingness to learn, but there will be people, not necessarily in the official ranks of the industrial corporations, who will consider it as fussy faddiness—which it most distinctly is not.

In comparing the corporation-built mining towns in some of the newer fields of the United States, with those of Nova Scotia, it should be remembered that the Nova Scotia companies never had the financial resources to warrant much heavier expenditures on housing than they have actually undertaken, for at no time in its history has any Nova Scotia coal company ever had sufficient funds at its disposal for necessary development work and capital expenditure on new collieries.

Builders of marine machinery in Canada are interested in the evident tendency towards oil-driven motors of the Diesel type employed in substitution for steam-driven motors, either of reciprocating or turbine type.

Mr. Schwab announces that Mr. Arthur West, the chief designer of the Bethlehem Shipbuilding Company, has perfected a Diesel-type engine, which, with one-half the number of cycles in use on existing types of Diesel engines, can be operated with one-third the quantity of oil hitherto generally used in marine oil-burning engines. Mr. Schwab says: "For the first time, an internal-combustion, heavy-oil engine has been perfected which produces the same horse power as a four-cycle engine practically twice its size, and is at the same time adapted to large cargo ships, while saving two-thirds in fuel cost alone, as compared with steam-driven oil-fired ships.

It is interesting to note that a Diesel-type oil-engine has been designed and built by the Canadian Steel Products Company, of Brantford, Ontario, which was shown at the Toronto Exhibition and attracted deserved attention as being a pioneer unit in Canada.

There are two things that are driving shipowners to adopt oil-propelled motors for ship production, first, the scarcity and high cost of coal, and second, the scarcity and unsuitability of boiler firemen. The second reason is probably the more important and the most permanent.

Canadian manufacturers of ship-propelling machinery will do well to adapt themselves to the new order of things.

JOSEPH PAXON IDDINGS.

A Profound Student of Petrology.

In a recent issue of "Science" the death is announced, at the comparatively early age of 63, of Joseph Paxon Iddings, formerly professor of petrology in the University of Chicago and at one time a geologist of the U. S. Geological Survey. Mr. Iddings became a member of the staff in Chicago in 1892, at the time of the organization of that geological department which has had such a great influence on the science through its students and the writings and research work of the members of the staff. The work of Chamberlin, Salisbury, Penrose and Iddings, all original members of the staff, has done, at least, as much, it is safe to say, to advance the science during the last thirty years as that of any other four men throughout the world.

During the closing decades of the last century, petrology, or as it was more commonly called petrography, was probably the most popular branch of geology among post-graduate students. The microscopic study of rocks in thin sections was really founded by an Englishman, Sorby, but like certain other sciences was developed in Germany. Heidelberg and Leipzig attracted practically all students of petrography from North America until G. H. Williams began his distinguished career as teacher and investigator on the staff of Johns Hopkins University, ending with his untimely death in 1894. Iddings' professorial work in Chicago continued until 1908. Through their teaching Williams and Iddings exerted a profound influence on petrography. After they took up professional work it was no longer necessary to leave North America for the best instruction obtainable in this splendid subject.

Iddings' epoch-making work on the rocks of the Yellowstone National Park and his books on Rock Minerals and on Igneous Rocks will serve as lasting memorials to his too brief career. The passing of his contemporaries at early ages, George H. Williams, J. Francis Williams and, more recently L. V. Pirsson, deprived petrography of profound students and investigators.

The Quantitative Classification of Igneous Rocks, the joint production of Cross, Iddings, Pirsson and Washington, has done much to make petrography a more exact science.

The igneous rocks have come to be recognized as the most important factors in the genesis of metalliferous deposits. Much of the research work of men like Iddings might appear to be of an abstract or academic nature, but, as in the case of other sciences, the study of the pure science has had a far reaching effect on the applied.—W. G. M.

Toronto, September 23rd.

BOOK REVIEW

Modern Tunneling. With Special Reference to Mine and Water-supply Tunnels. By David W. Brunton and John A. Davis. Linen Cloth Boards. 6 by 9 by 1¼ inches. 450 pages with Bibliography and Index. John Wiley & Sons. New York, $4.50.

This is a comprehensive treatise on the art of tunneling, more particularly as practised in connection with the extraction of minerals and in the drainage of mine workings. The authors are well known as experts on tunneling, and write from personal knowledge of many of the tunneling operations they describe. The section on "Tunneling" in Peele's mining engineers' handbook was prepared by them also.

The history of tunneling is concisely, but very interestingly dealt with, particularly in the recital of the achievements of the ancients in rock excavation with the aid of primitive appliances. Mention is made of the stupendous undertakings for mine drainage before the invention of the steam pump, the drainage depth secured being, to modern ideas, very disproportionate to the labor involved. A complete resume of modern tunnels, giving all essential particulars in each case, makes a valuable chapter.

The choice of power for tunnel work is considered from many angles, and much attention is given to all phases of air-compression in relation to tunneling. Ventilation, rock-drilling machines, haulage, and incidental surface and underground equipment are each discussed with numerous illustrations. The methods employed in drilling, blasting, removal of material and timbering are described and criticised. A large chapter is given to means of securing safety in tunneling work. Very detailed figures are given on the cost of individual tunnels, which include the Coronado, Gunnison, Laramie-Poudre, Lucania, Marshall-Russell, Mission, Newhouse, Rawley, Roosevelt, Stilwell, and Strawberry tunnels, and the Los Angeles Acqueduct.

A bibliography of sixty pages is appended giving the references to literature arranged under the sequence of subjects used in the chapters of the book.

The work is unusually well bound, and is printed on good quality paper. It contains information of value to the mining engineer having charge of underground excavations.

The authors state they have "endeavored to lay stress upon safe, efficient and economical methods, and upon good points of equipment, while bad practice and obsolete machinery is ignored, except, as examples of the inadvisable, or as they have some bearing historically."

THE METAL WORKING INDUSTRIES AND THE TARIFF IN BRITISH COLUMBIA

Mr. W. H. Cunliffe, of the Nelson Iron Works, British Columbia, giving evidence before the Tariff Enquiry Board, said that competition between the Nelson and Spokane foundries and machine shops was very keen. The tariff imposed by the United States being higher than that imposed by Canada, Spokane foundries were able to compete with Canadian foundries, and orders were accepted from Canadian buyers at much lower prices than asked of the American buyers in Spokane. The tendency of buyers to pass over small Canadian industries and go to the bigger centres in the South had resulted in the Crow's Nest Pass and Boundaries territories making purchases in the United States, the tariff protection given in Canada not acting as any deterrent to the placing of Canadian orders in the States.

Cape Breton Iron-ore Areas found Unsuitable.

The Dominion Steel Company have for some time been investigating the iron-ore occurrences which are situated at Loch Lomond, 35 miles from the Steel Plant at Sydney. The ore as found was of good quality, but diamond drilling proved it to be discontinuous and not present in sufficient quantity to develop as a source of supply.

Iron Ores of Commerce with Special Reference to Canadian Deposits

By SAMUEL GROVES, Ottawa.

In 1913, the production of iron ore by the larger nations of the world[2] was as follows:—

	Tons.
Great Britain	15,997,328
Canada	307,634
Newfoundland	1,433,858
Australia*	135,316
India	370,845
Austria-Hungary	5,098,324
Belgium	149,450
France	21,714,000
Germany	35,941,285
Italy	603,116
Russia	8,077,000
Spain	9.861,668
Sweden	7,475,571
United States	61,980,437

*1914.

"Ore" may be defined as a metal-bearing rock that can be exploited to economic advantage.[3]

The iron in the chief iron ores of commerce exists in nature as oxide, that is, the iron (Fe) is chemically combined with oxygen, together with an admixture of mineral matter : lime, alumina, magnesia silica, carbonic acid, phosphoric acid, bisulphide of iron, manganese, etc., and is found geologically, in veins, masses, and sedimentary deposits, either in the form of irregular fissure sheets, massive lenticular bodies, kidney shaped lumps, pulverized layers, or, as crystalline grains in beds of drift sand. The non-metallic minerals, or metalloids associated with the oxide of iron in the ore, are known, collectively, as **gangue**; and the larger part of the metallurgical process—converting the ore from a mineral condition in to a metallic state—consists in an effort to get rid of this extraneous material.

In travelling through a strange country, it is always an advantage to have a map showing known bounds and landmarks. In like manner, it will be advantageous in dealing with the history and technics of the iron ores of commerce, to map out a plan of procedure. I purpose, therefore, classifying the various kinds of iron ore, then defining and describing those found in the different countries of the world—in their respective order.

Classification of the Commercial Iron Ores.

OXIDES.—Anhydrous : Magnetite, Red hematite; Hydrous: Brown hematite.

CARBONATES. — Spathic, Clay-ironstone, Black-band ironstone.

Magnetite.

Magnetic iron ore, or magnetite (Fe_3O_4), contains, in its pure state, 72.41% of iron and 27.59% of oxygen. It is the richest of all iron ores, is widely distributed over the globe, and is indigenous to the Archaeozoie rocks. In pre-scientific days this ore was popularly known as "load-stone", from its power to act as a magnet, hence the name "magnetite." It is frequently found in the shape of dark, iron-grey, octahedral and dodecahedral crystals.

Its hardness is 6, and specific gravity 5.1. The lustre is metallic, usually brilliant; while the colour and streak are both black. In the lump form, magnetite is generally dense, hard, and comparatively free from gangue, which accounts for its extensive use in the manufacture of high-grade tool steel and cutlery-

Sweden.

Of magnetite deposits, that of Kilrunavaara-Luossavaara in northern Sweden, is probably the most important — as to quality and extent — yet discovered. This ore-body is situated on both sides of Luossovaara lake; and it is computed that above water-level there are 700,000,000 tons of payable ore in sight, with a total reserve of some 2,500,000,000 tons. The ore is of Bessemer grade, and has a metallic iron content of 63-64 per cent. The yearly production since 1893, has been 1.2 to 1.5 million tons.

But there is another Swedish deposit of magnetite, which, although not so large as the above mentioned ore-body, is one of the purest in existence, namely, the Dannemora mine, situated in the Upsala district of central Sweden. This particular deposit — which has been worked since the fifteenth century — is of fine quality, and has become celebrated, owing to the fact that the Dannemora magnetic ores have been utilized by the Sheffield steelmakers for centuries in the manufacture of high-grade cutlery, etc. So precious were these ores considered, that the output was limited to 50,000 tons per annum, while the selling price was almost prohibitory. The average iron content is 50%, with phosphorous 0.0025 to 0.005%; and sulphur 0.02 to 0.05%. It requires little flux in smelting, since the gangue is principally limestone — the natural flux.

While, however, special ores like the "Dannemora" have found favour in the manufacture of high-priced steel products, the general run of magnetic ores have been almost shunned; indeed there was a time when "tonnage" steelmakers, especially in the United States, depreciated and almost despised this class of ores, even though they were high-grade, because it had been found by experience that the hard magnetic ores would not mix satisfactorily in the blast furnace with the soft hematite ores; since they had different fusion levels: the magnetite needing more fuel than the hematite to dissociate the gangue and reduce the iron. But in recent years, the exigencies of competitive trade in high-grade steels has led to the sending out of search parties with dip-needle and stadia into every nook and corner of the earth.

Norway.

Prior to 1914, English ironmasters, face to face with the prospective exhaustion of the high-grade British ore mines, together with those of Bilboa, Spain — from whence, of late years, their most important supplies have been obtained — secured control of extensive deposits in the Dunderland district of Norway, the amount of which, above the surrounding surface

2. Statistical Report of the Iron and Steel and Allied Trades Federation, Great Britain, July 1916, p. 50.

3. Rickard: Mining Magazine, Vol. X, p. 257.

level alone, was estimated, in 1906, at 80,000,000 tons. This ore is largely magnetite, contains 40 to 45% of metallic iron, and is low in phosphorus. The hard ore has to be crushed, magnetically separated, and briquetted.

Japan.

The comparatively recent transformation of Japan from an almost exclusively agricultural to that of an industrial nation, has evoked an increasing demand in that country for iron and steel commodities, and a consequent need for iron ores. Far-seeing investigation of the mining and metallurgical methods of the progressive nations in the Occident, and the practical experience gained in the development of the magnetite mines in the Kamaishi district, and in the operations of the Imperial Iron Works — under the management of skilled European engineers — has given a great impetus to the iron trade of the at-one-time "hermit Kingdom." The primitive furnaces and forges begun by the feudal lords in 1868, for the manufacture of guns and cannon, made from iron sands found in the valleys adjacent to the sea coast, and originating in the disintegration and decomposition of the eruptive rocks, have been displaced by modernly equipped smelting furnaces, foundries, and steel works. With characteristic thoroughness Japanese experts — trained in the technical colleges of Europe and American — are making a profound study of the magnetic, physical and chemical properties of iron ores, and the conditions under which the ores of commerce are to be found, geologically.

A thorough investigation of the iron ore resources of Japan has recently been made under the auspices of the Mikado's government; and the published report shows that the productive ore deposits are limited to five areas (1) the magnetites of Kamaishi, Natakosaka, and Hitokabe; (2) hematites of Semin chiefly; and the iron sands in the Chugoku mountains. In 1917, the reserves were estimated as being as follows:—

Magnetite	35,000,000
Red hematite	30,000,000
Brown ores (limonite)	10,000,000

The total reserves for the islands alone being 80,000,000 tons.

From the foregoing estimate it will be perceived, that the resources of Japan are limited, and that continuity of her active, industrial policy, demands other sources of supply than those of her own ore fields.

The yearly production of the mines of Japan is about 150,000, tons: a supply altogether inadequate to meet the local demand, hence ores from other countries are imported, as follows: China, 100,000 tons; Corea, 50,000 to 70,000 tons; and over 400,000 tons from Europe and America. If Japan is to maintain a place in the sum, continuous importation on an increasing scale is a necessity; and since necessity is the mother of invention, her statesmen will invent a way of getting ores from nearby lands, where it is awaiting exploitation.

Russia.

Now that the Dardanelles is open to all nations, and the Black Sea has become a commercial water, it is within the range of possibility that transportation facilities will be provided from the Ural mountains down to tide water in the vicinity of the Crimea, and thus render the enormous magnetite deposits of the Ural available for Britain; in exchange for manufactures and commodities which will be much needed in the area of reconstruction and development now dawning upon Russia.

United States

In the Lake Superior region of the United States—notably in the eastern extension of the Missabe range—large deposits of magnetite are known to occur; but their iron content is low, consequently the output is small, being practically limited to two mines in Michigan.

Magnetite ores are also plentiful in the States of New York and New Jersey, but are, generally, of low grade; besides being high in sulphur, titaniferous, and pyrites laden: impurities which render the ores practically impossible in the ordinary blast furnace. But the introduction of modern ore dressing and concentrationary processess, supplemented by briquetting; and the economic utilization of such inferior ores in the electric smelting furnace — wherever "white coal" is available — will undoubtedly lead to increased mining activity in the last named States.

Then there are the soft, earthy, magnetites of Pennsylvania, of which, it is estimated some 40,000,000 tons are available, having an iron content of about 43%, with sulphur high, but phosphorus low. These ores are mined principally at Cornwall, Lebanon county, 25 miles east of Harrisburg, the Pennsylvania State Capital.

And even in the southern States — in Alabama, the occurrence of magnetite deposits are reported. Thus, not only in the northwest, but in the middle east, and south, magnetic iron ore abounds.

In recent years there have been numerous discoveries of magnetite in the Western States, principally in the Cordilleran region: the most productive mines being in southeastern Wyoming. Deposits "of economic importance," have also been found in northern California; but perhaps the most interesting find beds of rich, magnetic oxide (Fe_3O_4 79.06%) in the black sands along the Pacific Coast, south of the Columbia river. Experiments conducted in a temporarily erected electric furnace, under the personal supervision of Dr. Day, of the United States Geological Survey, disclosed the fact that, out of every ton of black sand treated, 683 pounds of iron were produced. A carload was found to be one-third pure magnetite.

An official report issued by the U. S. Geological Survey, in 1906, says:—

> It was found that the magnetite contained in the black sands of the Pacific slope constitutes a greater supply of useful iron ore than any other available source known on the Pacific slope. This magnetite usually contains from 5 to 10 per cent of titanium. It was found that this titanium offered obstacle to the production of high-grade cast iron in the electric furnace, and that in a modification of the electric furnace this cast iron could even be decarburized to a very soft iron of high quality. Facilities were not at hand for smelting this iron ore in an ordinary blast furnace.

Canada.

A reference to the statistical table on p. 1, will show that the iron ore production of Canada, in 1913, was only 307,634 short tons (1); whereas the United States produced 69,418,089 short tons. The comparatively

(1) Canadian iron ore production in 1919 was 197,170 tons; United States production 1918 was 78,017,271 tons.

insignificant production of iron ore in Canada is largely due to the fact that hitherto very few deposits of magnitude have been discovered which are large enough or high-grade enough to be workable at a profit.

The greater part of the known iron ore deposits of the Dominion are magnetic; which is explainable by the fact that magnetite is generally associated with the oldest rocks; and it is one of the canons of geological science that the so-called "Laurentian Shield"—which forms an irregular mass around Hudson Bay, extending south into Wisconsin and Minnesota — consists, predominantly, of Archaeozoic rocks, covering an area of about 2,000,000 square miles: over one-half the total area of Canada. This Pre-Cambrian "Shield" is said to have "apparently been subjected to prolonged and profound erosion, such, perhaps, as few other regions of the world have experienced." In the formation of the iron ore deposits associated with these plutonic rocks, oxygen played a less important part than in the care of hematite, hence the higher metallic iron content of magnetite. And an important feature of the Archaeozoic rocks is, the entire absence of fossils; which will account, somewhat, for the generally low phosphoric content of the hard, magnetic, iron ores; for wherever phosphorus — to any extent — is associated with magnetite, it is said to be largely due to metamorphism. On the other hand, these ores are almost invariably high in sulphur; titaniferous, and pyrites laden: impurities which render them—as already mentioned—practically impossible of reduction in the ordinary blast furnace. It was a knowledge of these serious technical objections to the use of Canadian iron ores, and a desire to provide an economic remedy, that led to the celebrated experiments in electric smelting at Sault St. Marie, in 1906: of which something will be said in a subsequent chapter.

Pig Iron (55 *tons*) *made from refractory iron-ores by electric-thermic process at Sault Ste. Marie,* 1906.

It has already been pointed out that the advance of the more powerful nations of the world in material civilization, has been largely due to progress made in the production of iron ores and to the degree of perfection attained in the workmanship of iron and steel. Keeping this generalization in mind, it can safely be said, that although Canada leads other nations in the production of non-metallic minerals such as gypsum, asbestos, and mica; and valuable metals such as nickel; and is at the same time one of the leading agricultural countries on the globe, yet, great material progress can not be expected in the future, unless iron and steel industries are developed. In view, therefore, of the meagre production of iron ores at the present time, it is pertinent to inquire what are the future prospects along this line of industry.

As far as can be gleaned from published reports and from data furnished by competent authorities, the magnetite iron ore situation of Canada in 1918, may be summarized as follows:

Three fairly large magnetite deposits in Canada, that approximate most nearly to commercial grade quality, are those of Bathurst, New Brunswick; Atikokan, Ontario; and those of the islands along the coast of British Columbia. Judged by modern ore requirements, none of these deposits are of exceptional size: the Bathurst reserve being estimated at 18,000,000 tons, having 43.7 to 47.5 iron content, with 0.64 to 1.04% phosphorus. Attempts to exploit the Bathurst and Atikokan ores have resulted only in financial loss.

As to the magnetite ores of British Columbia islands, the controllers of these important ore-bodies will have to establish smelters on Vancouver Island, and the pioneers of prospective iron and steel industries will find it necessary to secure permanent markets for their goods: inland up to the fringe of the great plains; and outside along the Pacific Coast southward, before success will crown their efforts. It will be a great venture; for they will find a keen competitor in Japan, on the one hand, and the United States on the other hand. On the western coast of the last-named country, immense deposits of rich black sands abound ; and the cheaply mined and transported ore of Cuba are also available — via the Panama Canal. All that is wanted is, abundant fuel and flux, and these can, in the near future, be procured cheaply and in unlimited quantity from the recently discovered coal areas of great magnitude in Alaska. Railways from these coal fields to the Alaskan coast are in process of construction, and a line of huge freight-carrying steamers are being built at the present time.

Ontario.

No magnetite bodies of importance have been discovered in the Rocky Mountain region or on the Great Plains; and it is not until we reach the "Laurentian Shield" in central Canada, that any iron ore deposits of magnitude have been recognized. Basing surmise on the fact that the eastern extensions of the wonderfully productive Vermilion and Missabe ranges of Minnesota cross the boundary line, and project many miles into western Ontario, high hopes were entertained of finding therein deposits of commercial extent and quality. But although large bodies of magnetite have been found in the Canadian part of the Missabe range, the iron content is so low, as to render exploitation and development altogether unprofitable at the present time. The only iron-bearing formation of supposedly economic value that has been mined in the Lake Superior district of Canada, is at Atikokan, 130 miles west of Port Arthur. It was discovered in 1882, by an Indian named Jim Shogonosh. The range in which this ore-body is found is a steep narrow hill 3800 feet long, with a maximum width of 400 feet, and a maximum height of 100 feet above the environing swamp. The rocks enclosing the ore are said to belong to the Keewatin — the oldest of the Archaeozoic — and consist, essentially, of hornblende-

chlorite schists, massive pyroxenite, etc., interbedded with irregular lenses of magnetite, running east and west, almost vertically. The hard, dense, magnetic ores are difficult to mine, and are impregnated with sulphides, hence have to be crushed and roasted preparatory to smelting. Between the years 1907 and 1912, some 90,000 tons of these refractory ores (averaging, iron 59.85%; phosphorus 0.11%; and sulphur 2.01%) were smelted in the Atikokan Iron Company's blast furnaces at Port Arthur. Since 1912, inertia has prevailed in the Atikokan iron-bearing region; operators found the mining unprofitable.

Some 500 miles eastward of Atikokan — almost in a direct line — we come to the next considerable deposit of magnetite in Canada: in the Moose Mountain district of Ontario, on the west branch of the Vermilion river, near Sellwood, 35 miles north of Sudbury (centre of the nickel mining industry of the Dominion), and about 82 miles from Key Harbour on the Georgian Bay. The extent of the iron ore deposits in this iron-bearing district has been widely heralded as being "enormous." Only as recent as February 1918, a prospector of repute (1) asserted that—

> There is a large amount of what is at present known as low-grade iron ore existing there for about 40 miles, with a width of from 500 to 1000 feet.... It is absolutely free from titanium, and reasonably free from phosphorus, and low in sulphur. There is also, apparently, a considerable amount of ore that would average over 50 per cent of iron.

On the other hand, a well known geologist and mining engineer, who has made a specialty of iron ore investigation, said, in 1919:—

> The magnetite deposits along the west branch of the Vermilion river, near Sellwood, extend 4½ or 5 miles. The deposits, while, extensive, are low-grade, and on account of physical peculiarities, can be concentrated magnetically only at a high cost. None of the ore is rich enough in iron to be merchantable as mined; much the larger portion of it carries less than 37%. Elaborate and costly experiments carried on for a number of years in an attempt to devise an economical product, have failed completely. Including a large plant for the extraction and treatment of the ore, these experiments are believed to have cost in the neighborhood of $1,000,000. How far they came from attaining commercial success may be judged from the fact that in spite of the great demand, and consequent high prices for iron ores, with a complete modern plant on the ground ready for operation, with abundance of ore ready for cheap mining, and with strong financial backing, not a ton of either concentrates or briquettes have been shipped since 1915. (1).

It is evident from the foregoing facts, that owing to the available, cheap, abundant, high-grade ores of the U. S. Lake Superior region on the one hand, and the high cost of mining and preparing for utilization the lower-grade ores of the Moose Mountain district on the other, that there is no immediate prospect of a great iron ore mining industry in northern Ontario. But, as already pointed out, the phenomenal industrial rise of the United States began with the discovery of the immense Missabe iron ore deposits of Minnesota, in 1890. And it is within the range of probability, that in the near future rich iron ore deposits of magnitude may be uncovered in northern Ontario, in the practically unexplored regions south and southwest of Hudson Bay. Only recently, the Provincial geologist of Ontario announced (2) the discovery of a buried iron ore range — of Keewatin age — just south of Sharp landing, near New Liskeard, on the northwest shore of lake Temiskaming. This buried iron range is said to extend northwestward through Hudson township. It is reported as being overlain by Niagara limestone and recent clay deposits, in addition to the Temiskaming and Cobalt series, hence has not been subjected to glaciation — which has been the bane of the iron ore deposits of Ontario hitherto utilized. Angular blocks of iron ore, having a like formation to the one above mentioned, have also been observed in the townships of Coleman and Boston. These and other promising indications of iron ore resources are all within measurable distance of the Northern Ontario and Temiskaming railway, and the Grand Trunk Pacific system; and since there is abundance of limestone flux in the vicinity, and charcoal and "white coal" fuel available, a future iron and steel industry in this region is not improbable.

(1) T. R. Drummond, in "Iron and Steel of Canada," Vol. 1, February 1918, p. 42.

(1) In 1918, operations were resumed at Sellwood; and there was an important production of magnetite briquettes from the milling and briquetting plant. The Mines Branch official report says that the ore milled averaged about 33.8 per cent in iron, while the briquettes produced contained about 61.1 per cent.

(2) Report, Ontario Bureau of Mines, Vol. XIX, Part II, 1913, pp. 58-9.

(To be Continued).

OLIVER IRON MINING CO. SUED FOR ALLEGED INFRINGEMENT OF ORE WASHING PROCESS.

A $40,000,000 suit by Capt. Alexander McDougall, of Duluth, against Oliver Iron Mining Co. for damages in connection with alleged infringement of an ore washer process is on trial in Federal Court here before Judge Booth of St. Paul. Plaintiff claims damages at rate of $2 a ton on ore mined by defendant company between 1913 and November, 1918, and treated at its ore washing plant at Coleraine, Minn.

In evidence presented, attorneys for Capt. McDougall sought to prove that no genuine difference exists between the washer he invented and the type used by the iron company. Plaintiff alleges he submitted his invention to defendant company in 1908, and was informed that use could not be made of the stripping device, but the usefulness of the ore-washer was not denied.

Oliver Iron Mining Co. is contending that the McDougall patent is invalid, since a similar ore washer had long been in use. It denies that John G. Greenway, an engineer in its employ at the time, filed a patent for an ore washer after he had seen the McDougall invention, and that the former's device was based on the latter.

A Direct Process for Making Iron and Steel from Ore

In a new process described below, the blast furnace is eliminated and metal produced from ores of all types.. It is applicable also to certain non-ferrous metals.

By JAMES W. MOFFAT, M.E.I.C.

Direct processes aim at the production of steel direct from iron ore without the intermediary of the blast furnace. The electric furnace in one form or another is usually associated with the majority of smelting processes of this character put forward in recent years and with but one exception, reduction has been attempted either on the furnace hearth itself or in some attached device forming a portion of the furnace assembly. A process has been recently patented by the writer (Canadian patent No. 186,994; U. S. patent No. 1,294,514); and other countries; in which the reduction is accomplished in a separate mechanism and the melting down of the metal and its subsequent refining take place in the electric furnace proper.

In its essentials the process thus, consists of the duplexing of two known types of furnaces, — any metallizing and any electric furnace. By this combination and with the type of metallizing or reducing furnace employed, economies are effected which place the direct metal process on an excellent competitive footing with the blast furnace and open-hearth for steel making, and, what is of equal or greater importance, ores unsuitable for blast furnace use, are made available.

The utilization of many Canadian ores is not economically feasible in the blast furnace since ores requiring concentration and some form of subsequent agglomeration into a suitable physical state are unable to compete in cost with the hematite ores of the Mesabi and other well known ranges, both Canadian and American.

For blast-furnace use ores of a comparatively high iron-content are required, and their physical condition must be such that they will stand transport and the crushing effect of the blast-furnace burden without an undue production of fines. For the successful reduction of ores other than these on a commercial basis, a process should take the ore directly after concentration or benefaction without nodulizing or briquetting. If this were possible the availability of ores suitable for the production of iron and steel would be vastly increased. Magnetites requiring concentration, soft and low-grade hematites, and cerbonate ores, all would be of economic importance in this connection.

Generally the benefaction of ores for the enrichment of the metallic content or the removal of injurious constituents, leaves the ore in a state of fine subdivision and in this state they are admirably adopted for use in the metallizing furnace which forms the first step in this process.

Ores rich in metallic content and not requiring concentration, can be used with equal facility, but require crushing and pulverizing to pass through say a ten-mesh screen before they can be used in this process. Porosity of the ore, however, is of much importance and in the case of a porous ore particles passing through a five-mesh screen may answer to reduction as readily as those passing through a ten-mesh screen, through double the diameter.

Ores low in metallic content should be pulverized to the grain size affording the best separation of the metallics from the gangue, even if all ground to pass through a 100 mesh screen. Concentration of these to a high grade is much more economical than charging a lot of rock matter into an electric furnace with lime additions to obtain a suitable flux for it, melting it with an expensive heat, and removing it as a slag. The last-mentioned way burdens a furnace with rock melting instead of metal melting and so decreases the useful output.

The reducing or metallizing of metallic oxides in the past, has been effected with more or less success, as part of some continuous process where the product was not definitely a completely reduced sponge, but was only a partly reduced one much intermingled with other material. To avoid trouble in the electric furnace from scouring slags due to the presence of metallic oxides, it is evident that the sponge must be a completely reduced one and also if it is to be transferred hot from the metallizer to the melting furnace, no air must be permitted to get at it, else re-oxidation will occur.

The product is known as "iron sponge" and is defined by Raymond as "metal in the porous form obtained by reduction without fusion."

Naturally the finishing of the metal in the melting furnace makes the procecss a discontinuous one, but more convenient in operation and more suitable for melting trade demands, hence the iron sponge is made in batches, and the steel or iron produced in separate heats. This has been proven by long experience to be the only successful method of making steel as the use of individual heats is necessary for the refining operations upon which the metallurgy of steel is based. The open-hearth, the Bessemer converter and older steel-making processes, are all of this type. The blast-furnace is of course a mechanism which operates continuously, and, in the line of electric smelting, previous attempts have endeavored to follow the same principle but without success.

The Metallizing Furnace.

For success in duplexing the metallizing and electric furnaces, it was apparent that a more practical furnace than any hitherto used should be developed to completely de-oxidize the ore and be so designed that the operator, having modern scientific apparatus to guide him, would have perfect control over the entire operation, and be able to supply completely reduced sponge to the electric melting furnace at regular intervals of time. This metallizing furnace has also been patented in Canada, the United States and foreign countries: see accompanying illustrations.

The transfer between the furnaces is so arranged that the sponge is delivered into the electric melter without fear of re-oxidation, this furnace being provided with a charge-opening centrally above the bath, so that the falling charge is deposited there on in such

shape that it does not require any subsequent dressing with furnace tools, which would be a difficult thing to do and exclude all air at the same time.

The metallizer is mechanically rabbled from the beginning of the charging to the very end of the discharge, and that in as intensive a manner as possible, so that every particle of the ore of the charge is of like temperature and condition of de-oxidation. Such rabbling aids materially in preventing agglomeration and the uncertainty of complete reduction in the interior of the lumps that might be formed without it.

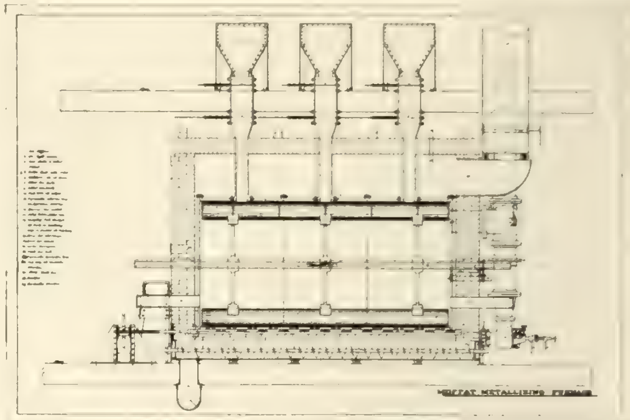
The furnace is designed so that the charge can be held in it until the chemist reports complete reduction and a proper amount of carbon present for the work to be done in the electric furnace. These necessities exclude furnaces with continuous charge and and discharge such as rotary-tube roasters.

The gases for the required temperatures and for the reactions of reduction must be kept apart if complete as assured work is to be done. This again excludes such furnaces as rotary tubes, reverberatories, furnaces of the shelf type, etc.

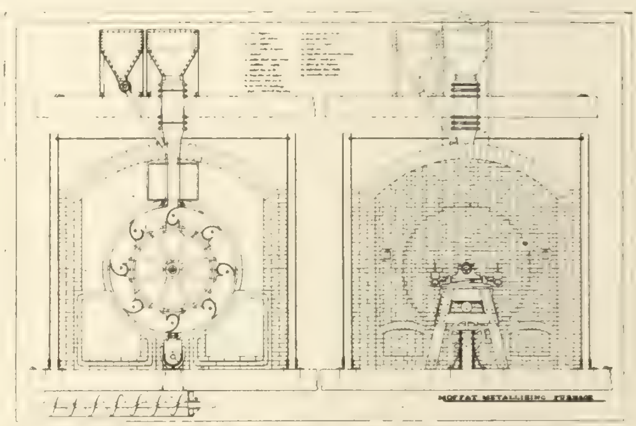
It is convenient while heating the ore to the higher reducing temperatures to at times substitute a suitable oxidizing atmosphere for the reducing ore within the retort, so that sulphurous ores can be well desulphurized and so lessen the amount of work done with slags in the finishing of the metal in the electric furnace.

A granular sponge is much preferred to even a slightly agglomerated one as it will be transferred with very much less trouble and will cause no sticky adhesions on the rabbles and other parts of the apparatus. This sticky condition is frequently seen in rotary roasters operated under the temperature required in reduction, where the ore rolls on itself as the tube revolves and a lumpy product is almost sure to mean only a partly reduced one. It is clearly seen that the ore should be presented to the action of the reducing gas in discrete particles, and these particles should be presented to the gas as constantly as possible.

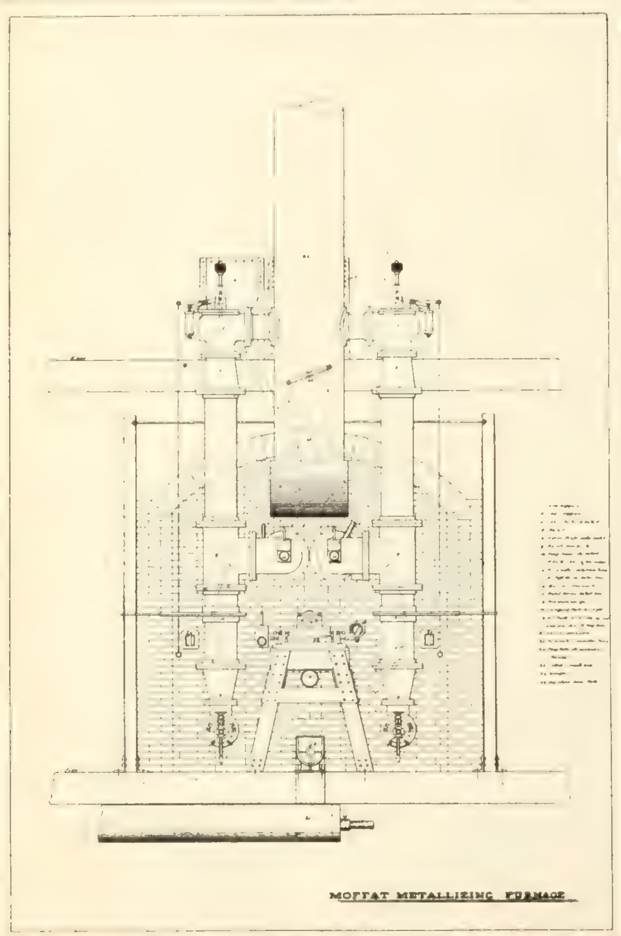
The furnace is designed to receive the charge through a mechanism that practically prevents the entrance of more air than is contained in the voids of the pulverized ore. The charge is mechanically rabbled all the time and kept at a proper temperature for the progress of reduction; recording instruments



LONGTIDUNAL SECTION



REAR VIEW AND END SECTION SHOWING RABBLING DEVICE



FRONT VIEW

are provided for the guidance of the operator in accurately controlling the heat entering the retort from the heating chamber, and for the analysis of the gas in the former, when desired; means are provided for taking samples of the ore without any re-oxidation of it taking place; peep-holes are arranged so that the operator may see a large portion of the interiors of the combustion chamber and the retort, those used in the latter being air-tight; the furnace is capable of quick mechanical discharge into air-tight conveyors delivering the sponge into the electric furnace with a minimum loss of heat in it at the completion of the reducing process; it is also capable of holding the charge until the electric furnace is ready to receive it. Errors in the work of reduction by the operator are easily corrected.

Operation of the Metallizer.

Theoretically, to provide for complete reduction, carbon must be introduced to the extent of from 24 to 26 per cent of the weight of metallic iron present

in the ore. To this weight is added a further 10 or 12 per cent of carbon making a total of approximately 35 per cent, and is fed into the retort already containing the entire charge of ore preheated to about 300° C., in such a manner as will permit of a usable volume of gas being given off in volume sufficient to satisfy the burners which are used to generate heat externally to the retort. As the ore nears complete reduction and its oxygen content nears exhaustion, the gas may be cut off from the burners and allowed to escape through relief valves to the waste stack. The necessary heat requirements are then met by means of oil or any other suitable fuel.

The excess of 10 or 12 per cent. of carbon above the weight required for complete reduction is for providing a flow of gas from the retort of higher calorific value than would be given off otherwise, that is the gas is made richer in carbon monoxide. Some of the gas is sure to be wasted but the operator will soon learn to usefully use nearly all of it.

In the last century Sir Lowthian Bell, in his research work on the smelting of iron ores, found three critical points in the reduction of iron where it would cease if the ration of carbon monoxide to carbon dioxide was less than certain amounts at certain temperatures. Only two of these, however, come within the range of temperature required and are as follows:

Reduction will cease at about 500°C if the ratio of CO to CO_2 drops to 0.667; and reduction will cease at about 750° C if the ratio of CO to CO_2 drops to 2.125.

Two points are not sufficient for making a graphic chart of accuracy, but since Sir Lowthian Bell's time further research work done upon the reduction of iron ores enables us to prepare an accurate chart of the equilibrium curve on one side of which reduction takes place and on the other side oxidation so that now the operator has only to read the retort pyrometer and the gas recorder and then refer to the chart, or table corresponding to it, to know whether the furnace is reducing, neutral, or re-oxidizing.

If reduction is not proceeding properly it is an easy matter for the operator to increase the relative volume of CO present.

The finished sponge should contain sufficient carbon to supply the following demands: — carbon required in the finished metal in the electric furnace; carbon required to complete the calcination of the lime additions; carbon required to reduce any oxide accidentally present; and carbon sufficient to meet any loss of it during the melt-down, as absolutely air tight conditions are not possible even in the electric furnace.

This carbon, in excess of the amount required for complete reduction in the metallizer, does not burn or assist in the formation of gas, for after reduction is complete there is no oxygen in the retort to make it possible.

The composition of the iron sponge is always completely under the control of the operator assisted by the chemist. If incomplete reduction is reported with insufficient carbon present, the correction is made by adding carbon and continuing the operation; if too much carbon is present, by adding ore and continuing the operation; if the desired amount of carbon be present and the reduction is still incomplete correction is made by adding more carbon and continuing. In the case of complete reduction and insufficient carbon being present, the correction is made by simply adding more carbon to the amount as advised by the chemist. If on the other hand too much carbon is present, the correction is best made by adding sponge from a completely reduced stock which has been cooled down with the air excluded. If reduction is complete and the correct amount of carbon present the sponge is ready to be charged into the electric furnace as soon as the latter is ready.

Lime additions, for fluxing, preheated to 250°C or 300°C are charged and thoroughly mixed with the sponge by the rabbler.

The waste gases of the stack may be used to preheat the materials of the charge to 250 deg. or 300 deg. C, and also for the elimination of moisture from the carbon.

Capacity of the Metallizer.

Handled in this way the process of reduction becomes a much more rapid one than the reduction of lump ores and a battery of metallizers making the sponge necessary for an electric furnace can, by alternate charges, supply two melting furnaces. The time required for the transfer of the sponge is about ten minutes, an important saving of time when compared to that required for the charging of cold scrap.

As the charge of sponge is already heated up when delivered to above 700°C., that is to at least 40 per cent of the temperature, it will attain at the completion of the period of melting, it is evident that the time required to melt down a hot sponge charge will be at least one hour less than with cold scrap.

From a commercial point of view the saving with each electric-furnace heat of an hour's use of the electric current, an hour's time of every man employed on the electric furnace, and an hour's consumption of electrodes, forms an important economy. But the economy does not altogether stop there, for charging hot sponge is much easier on the roof and linings as these do not suffer from the chilling which accompanies the opening of doors and the charging of cold scrap, nor is the bottom given the severe wear that it is subjected to when cold scrap is thrown in on it.

Power companies will not object to the use of their current on electric-furnace work when hot sponge is used as the charge instead of cold scrap, as on starting each heat, inductive troubles, with consequent lowering of the power-factor, and short circuit conditions are absent.

European Practice.

In Sweden an electric stack-furnace reduces lump ore, with a maximum of 20 per cent. of ore fines in the charge, and melts it down into a white iron, with a consumption of about 1.0 kw. hrs. per lb., or 2240 kw. hrs. per gross ton. The metal is then transferred while hot to an electric finishing-furnace where it is converted into steel with a further consumption of about 300 kw. hrs., making a total of about 2,500 kw. hrs., used per ton of steel made, or about 1,750 kw. hrs., more than is used in the electric scrap-melting furnace.

Advantages of this Duplex Process Over the Electric Shaft-Furnace.

In reducing the ore the use of expensive electric energy is entirely dispensed with, and waste gas from reduction with carbon is substituted as the main source of heat.

The waste gas is readily beneficiated in calorific value by the addition of a comparatively small amount

of carbon during reduction, and where required, some further heat can be supplied by the use of any convenient and economical fuel.

During the period of reduction in the metallizer, oxide ores containing an undesirable amount of sulphur will be greatly beneficiated without any special system of roasting being used.

The process calls for the use of pulverized ore only, and conseuqently lowgrade ores are made available for use by concentration without sintering, nodulizing or briquetting.

No high-grade lump coke is required to maintain voids for the passage of gas through a slowly descending charge. The cheapest form of coal — that is, clean screenings — is used in the metallizer.

The perfect control over the metallizing of the oxides is a prominent feature.

The practice can be adjusted to make various kinds of metal such as iron, low-carbon and high-carbon steels, alloy steels,, cobalt and nickel from their oxides, etc.

Advantages Over Scrap-Melting Electric Furnaces.

In melting the sponge an important part of the expensive electric heat and of the labor and other expense is saved by charging the sponge red-hot.

For the same reason the number of heats that may be made in the 24 hrs., is increased when red-hot sponge is charged in place of cold scrap and such sponge is cheaper than the scrap.

Other Uses for the Metallizers.

When these furnaces are to be used for partial reductions to obtain a magnetic product, the screw conveyor into which the hot partially reduced ore is charged should be provided with a hollow shaft and the conveying boxes with a double wall so that cold water can be freely circulated through them to secure a quick cooling of the product and thus render them more amenable to magnetic separation as well as preventing injury to the magnetic separation itself.

Magnetizing the Oxide Ores.

Hematite, (Fe_2O_3 = 70% Fe+30% O), limonites, ($2Fe_2O_33H_2O$ = 59.8 p.c. Fe+25.7 p.c. O+14.5 p.c. H_2O) and ores of similar nature are but feebly magnetic and do not respond successfully to magnetic separation. To overcome this a partial reduction to a magnetic oxide is usually made.

Using this furnace the procedure is as follows: — the ore is preheated as already described to a temperature of say 300°C and is then charged into the the heated retort and carbon supplied. The reaction $3\ Fe_2O_3+CO = 2\ Fe^3O_4+C_2$ begins at once, but is slow until a temperature of 425°C is reached, when it becomes rapid and can be complete at about 450°C, but may be continued until 500°C is reached.

As the heat in the charge will be largely lost when it is cooled down sufficiently to be passed through a magnetic separator it does not appear to be advantageous to reduce it to a lower oxide than Fe_3O_4. Care must be taken that the product be cooled below oxidation temperature before air has access to it. At this stage of reduction, if the product is all Fe_3O_4, 11% of the oxygen present in the Fe_2O_3 will have been removed. The theoretical amount of carbon required for the process is 3.6% of the weight of the iron present; usually it takes from 3.6 to 5.0 per cent of carbon.

Calcining the Carbonates.

Siderite ($FeCO_3$ = 62.1% Fe O + 37.9% CO_2) when heated to a temperature of 800° C breaks up into Fe O and C O_2. In a neutral atmosphere the Fe O is converted into Fe_6O_7, but if it is slightly oxidizing Fe_3O_4 is formed. Both of these oxides are strongly magnetic. Usually from 3 to 5% of carbon is used in the operation.

Other Use for Iron Sponge.

Apart from its function in the production of metals from its ores this reducing furnace may be expected to play an important part in the metallurgy of copper. Iron sponge has long been recognized as one of the best of precipitating agents for copper recovery and only the difficulties surrounding its manufacture have prevented its general use. Being light and of a porous nature a very large surface is exposed to the liquors for its weight. On this subject it might be timely to quote Liddel:—

"Scrap iron after the floating supply of tin cans has been utilized is likely to be an expensive commodity. Using a fairly pure copper sulphate solution the consumption of iron is likely to run from 1¼ to 1½ lb. of iron per pound of copper produced. When the solutions are high in chorides as in the Dotsch process at Rio Tinto, the consumption of iron is said to run as high as 2½ lb. of iron per lb. of copper produced. However, I do not feel that the possibilities of sponge iron, i.e., iron produced by the reduction without fusion of ferric oxide, have by any means been exhausted and that the great hope of chemical, precipitation lies in this material." *

*Metallurgists and Chemists Handbook, page 570, Liddell.

COURSE IN METALLOGRAPHY AT McGILL UNIVERSITY.

Messrs. Harold J. Roast, F.C.S., F.C.I.C. and C. F. Pascoe, F.C.I.C., will give a course in Industrial Metallography. This course is the same as that previously given, and consists of fifteen periods equally divided between ferrous and non-ferrous metals. Provision can only be made for twelve members.

Any desiring to join should write either to Dr. Stansfield, McGill University or to the lecturers.

The fee is $20.00 payable to the Bursar, McGill University.

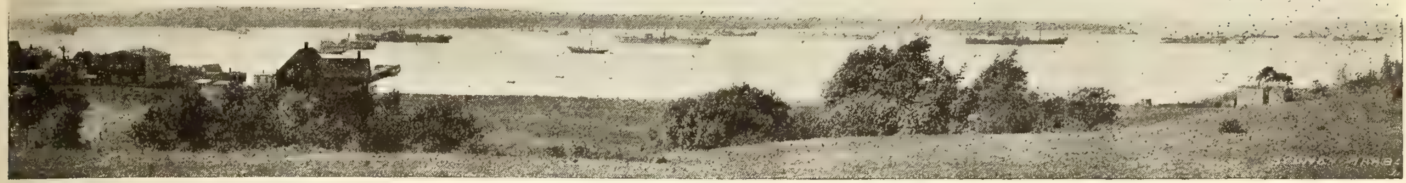
The Class starts at 8 p.m. Monday, Nov. 8th, at the Chemistry Building, McGill University.

NIPISSING COMPANY OF COBALT PURCHASES MAGNETITE MINE IN NEW YORK STATE.

Nipissing Mines Co. has purchased Magnetite Mines Co., an iron property some 60 miles from New York City. The property contains, it is estimated, ore reserves of many millions of tons, and up to time of its shut-down, 30 years ago, constituted the largest working iron deposit east of the Mississippi. Both the New York Central and the New Haven could serve the new acquisition of Nipissing.

It is understood the purchase price, together with cost of erecting a plant, does not entail much over $1,000,000. Nipissing has a surplus of between $5,000,000 and $6,000,000.

The ore runs about 37 per cent iron and concentrates about two into one, with a resultant product averaging 60 per cent iron. It is believed this would find a ready market, but greater profits would probably result from a pig iron product. This would entail erection of blast furnaces.—Boston News Bureau.



SHIPBUILDING

HALIFAX SHIPYARDS LIMITED.

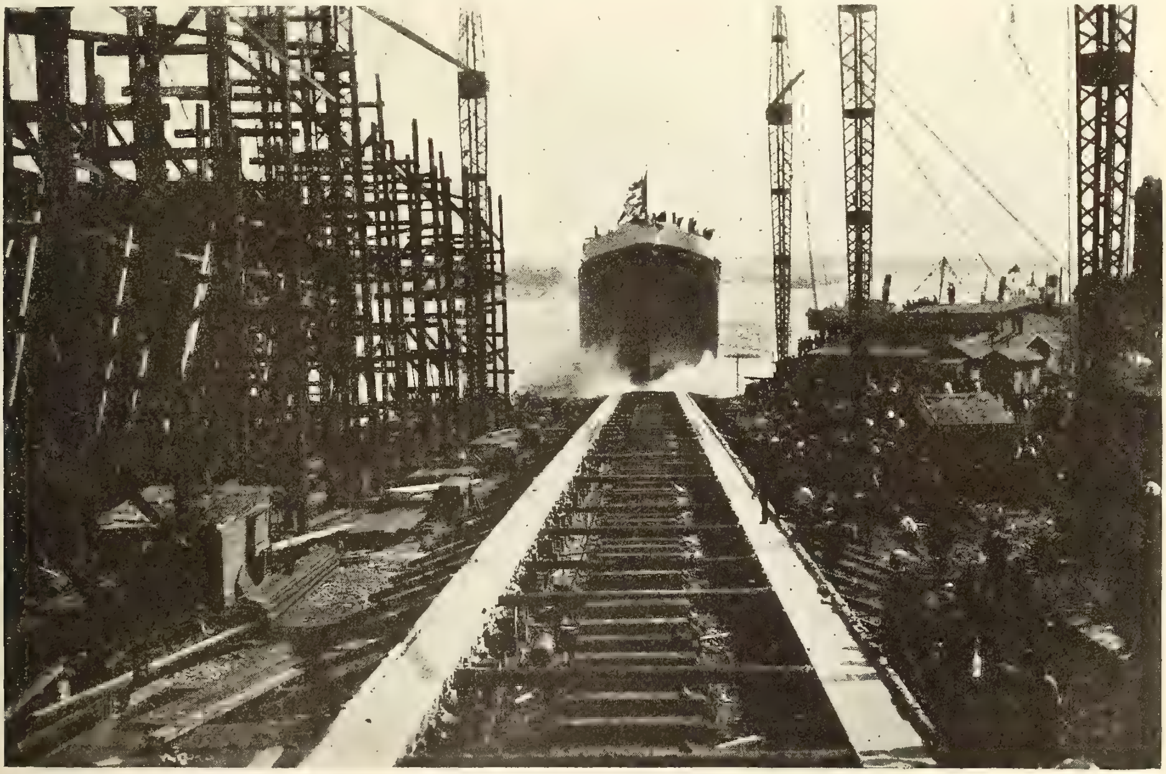
Our February issue contained a fully illustrated description of the enterprise of the Halifax Shipyards, Limited, prepared by Mr. D. E. O'Brien, the Chief Engineer. By the courtesy of Mr. J. E. McLurg, Manager of the Shipyards, we are now enabled to show views of the launching of the "Canadian Mariner", and one of the dry-dock, a comparison of which with those contained in the February number will demonstrate the rapid progress made at this yard.

The launching of the "Canadian Mariner" on September 4th was made the occasion of a gathering that included, in addition to the officials of the Halifax Shipyards, The Lt. Governor and Premier of Nova Scotia, and the Deputy Minister of Marine & Fisheries. The significance of the launching of the first steel vessel constructed in Halifax was not lost upon the gathering. As was pointed out by Mr. Alex. Johnson, the Deputy Minister, dreams of steel-shipbuilding in Halifax are of long date, and the realisation of these dreams, although after many days, brings Halifax much nearer her destined future, namely, a maritime metropolis of first-class rank.

The "Canadian Mariner" is Hull No. 1, and her launching will shortly be followed by that of the "Canadian Explorer", Hull No. 2, both vessels being of exactly similar type and dimensions. Dimensions are, length between perpendiculars, 400 feet., breadth 52 ft., depth 31 ft., loaded draft 25 ft. 1 in., speed eleven knots, deadweight capacity 8,350 tons, built to Lloyd's specifications. These dimensions are similar to that of the standard type of vessel constructed at various Canadian shipyards to the order of the Government.

In addition to these two vessels, the Shipyards have under construction two 10,500 ton ships, building to the order of the Canadian Government, of following dimensions:

Length between perpendiculars	430 ft.
Moulded breadth.	56 ft.
Moulded depth.	30 ft.
Deadweight carrying capacity, about. .	. .10,500 tons



Launching of the S. S. "Canadian Mariner", Halifax Shipyards, 4th September, 1920.

There is a possibility that a contract may be closed for several oil-tank steamers of larger tonnage than any vessels yet quoted upon at this yard, but it is understood the matter is still under consideration.

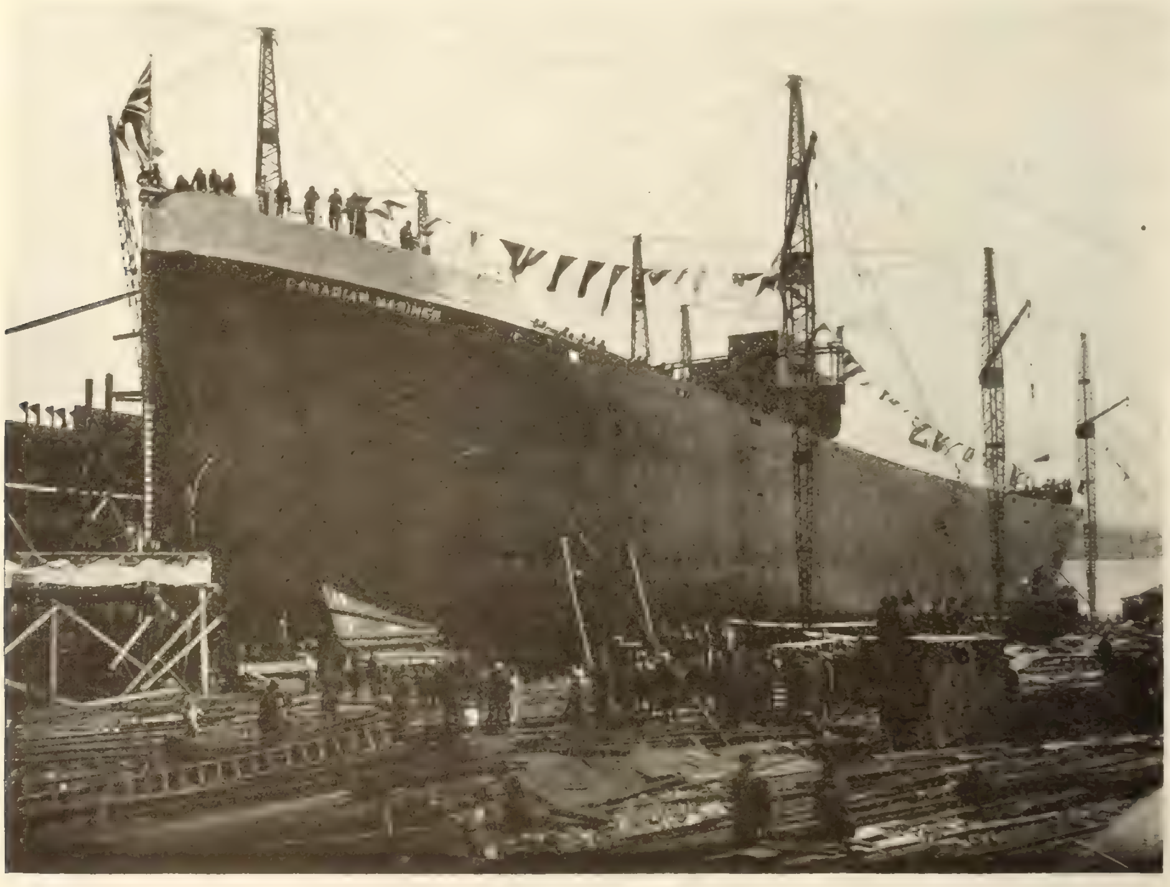
In addition to shipbuilding, the Shipyards are continually carrying out repair-work to hulls, engines and boilers of vessels. It is not generally known that in addition to the Halifax Plant, the Shipyards own and operate four marine railways on the Dartmouth side of the Harbor, in connection with which are up-to-date machine and boiler shops equipped for all kinds of repairs. In the photograph accompanying the Prince Edward Island Government ice-breaker and car-ferry is to be seen, placed in the dry-dock for overhauling. In the past, Halifax has often seen "lame ducks" brought in for temporary repairs, sufficient to carry injured vessels to New York for permanent repairs, but, with the facilities now possessed by the Halifax Shipyards, it is hoped that less of this temporary work will be quoted on, and that the generally unsatisfactory character of such temporary repairs, and the danger to which damaged ships are exposed in making a southern port, will become unnecessary.

Mr. Roy Wolvin, the President of the Dominion Steel Corporation, at the luncheon which followed the launching, stated that Halifax was decided upon by the Minister of Marine, Hon. Mr. Ballantyne, Mr. Norcross and himself, because of its obvious advantages as a point for ship repairs and shipbuilding, being advantages as a point for ship repairs and shipbuilding, being "the nearets point for repairs on a great trade "route, open twelve months in the year, and with high- "class labor available."

The coherent nature of the Canadian Government's plan for creation of a national mercantile marine is now becoming apparent. With a fair start made towards the creation of adequate ocean terminals at Halifax—for of course the existing provision of terminal piers is only partial—a well-equipped shipbuilding yard, with a most excellent site, on a good accessible harbor, connected with one of the finest land-locked harbors of refuge in nature, namely Bedford Basin; combined with the modern ship-plate rolling mill at Sydney, and the marine-forging equipment of the Nova Scotia Steel & Coal Co. at New Glasgow, the Halifax Shipyards should grow into an indispensable national asset.

The Canadian Government appears to have realised its omission to assist shipbuilding before the war, at the time that British registration was made compulsory for Canadian coastal trade, and the policy pursued in recent years will in the future be looked back upon as the work of wise and far-sighted believers in the maritime future of Canada.

During the Summer, the Halifax Shipyards were hindered by the presence among their workpeople of labor extremists, but at this time there is entire harmony between the management and its staff of workers.



S. S. "Canadian Mariner" ready for Launching.

NOVA SCOTIA STEEL & COAL COMPANY'S SHIPYARD.

The S. S. "Volunda" recently launched at the New Glasgow yard of the Nova Scotia Steel & Coal Company, made her trial trip on the 25th September.

A steel vessel of 2,500 tons capacity is under construction, and a steel pleasure yacht, for an American owner, is approaching completion. This vessel is unique in being the only steel pleasure yacht built in Nova Scotia.

While New Glasgow people do not fail to share in the satisfaction of seeing in Halifax a shipyard that is capable of turning out large steel vessels, they do not forget that New Glasgow had the honor of constructing the first steel vessel of ocean-going size constructed in Nova Scotia, and that the local yard was one of the first to build steel vessels on tidewater in the war period. There was much scepticism in those days that now seem so remote, but are really only recent of the ability of the local steelworkers to build a seaworthy craft with the limited resources at their disposal, but they did it, and thereby gave an impulse to steel shipbuilding in Canada that went far beyond the confines of Pictou County.

Vancouver, B. C.

The Foundation Company's yard at Vancouver has been completely dismantled and the equipment disposed of. The Harbor Marine Co. of Victoria, Yarrow's Ltd., of Esquimalt ,and the Cholberg Yard, have obtained portions of the equipment sold. The Foundation Company built wooden ships on a large scale, having at one time 4,000 men employed.

Victoria, B. C.

The Harbor Marine Yard launched the Canadian "Traveller" on September 29th. The Canadian " Winner ", the other ship built in this yard will sail for Australia with cargo towards the end of October. One hundred and fifty men were laid off following the launch of the "Traveller", and it is expected that operations will cease entirely following the completion of the "Winner", these two vessels comprising the whole of the building programme. The workmen at this yard were very largely returned soldiers, and the nature of their future employment is causing some anxiety.

Montreal.

The Canadian "Runner" built by the Port Arthur Shipbuilding Co., of which particulars were given in our last issue, has been joined together by Canadian Vickers, and will shortly be ready for service.

The "Squatter" and the "Carrier", the first-named from Welland and the last-named from Port-Arthur, have come down the lakes in sections, and will be fitted together in the Canadian Vickers establishment.

The "Conqueror", built by Canadian Vickers, has been accepted by the Government following successful trial trips.

Welland.

The Plant of the British American Shipbuilding Co., at Welland, will be permanently closed down, and the equipment disposed of. With the completion of the "Canadian Squatter" the programme of this yard is completed. Since operations were commenced at Welland, five freighters have been built, involving approximately a disbursement in wages of $1,500,000. At the busiest period 570 men were employed.

Prince Edward Island Government Ice-breaker and Car-ferry in the Drydock of Halifax Shipyards, Ltd.

The Development of the Steam Engine in the Maritme Provinces of Canada

D. W. ROBB, M.E.I.C.

Advance proof of paper to be read before the Engineering Institute of Canada at Halifax, October, 14, 1920.

Although Nova Scotia, New Brunswick and Prince Edward Island, the Maritime Provinces of Canada, are more widely known for the extent and importance of their fisheries, lumbering, mining and some deparments of agriculture, particularly apples, potatoes, etc. than for mechanical and engineering achievement, it is interesting to find that in the early development of steam engines for steamers, locomotives, and later in connection with electrical apparatus, a department of engineering which has contributed more towards the rapid progress of the world during the nineteenth century than any other; the little provinces by the sea were among the first on this side of the Atlantic.

When we remember that the first practical steam engines were built by Watt from 1775 to 1800 and that we are only now celebrating the centenary of Stephenson who started the steam locomotive on its triumphant career, it may surprise many of us to find that as early as the years 1844-48 and 1854, John Waring and John Smith, pioneer engineers of St. John, N.B., designed and built marine engines for steamers running on the St. John River. Stationary engines were built by Fleming & Humbert at St. John, N.B. as early as 1838, and locomotives were built by Mr. Fleming before 1860. One of Mr. Fleming's locomotives hauled a train for the late King Edward, then Prince of Wales, when he visited Canada in 1860.

It may be interesting to give a few particulars in regard to the steamers and engines referred to above. I am indebted to Captain R. Retallick of St. John, who has sent me, through Geo. H. Waring, grandson of John Waring one of the pioneer engine builders referred to above, the following particulars :

The steamer "Reindeer", for service on the St. John River, was built in 1844. Her engines were compound, the high pressure cylinder being horizontal with Stephenson link motion and the low pressure cylinder oscillating. Captain Retallick states that this was the first compound engine that was run successfully, (probably he means for marine service), but it must have been among the first compound engines built for any purpose. This engine was designed by Tippitts and Waring — built by John Smith at St. John, N.B., and must have been of good design and construction as it was transferred to the steamer "Antelope," also a river boat, in 1861 and later installed in the steamer "Admiral", which was broken up in the year 1915, so that this engine passed the scriptural "three score and ten."

The steamer "John Waring" was built in 1848 at Woodstock, N.B. by Mr. McConnel. The engines were built by John Waring and had two high pressure cylinders. The boat was a side wheeler as the water is very shallow at Woodstock The "John Waring" was launched under steam and came direct from Woodstock to Indiantown, just above the reversing falls at St. John, about 140 miles She was considered very fast.

The next steamer, Captain Retallick states, was the "Anna Agusta" built at Fredericton. The engine was a horizontal low pressure, or single cylinder engine, placed on one side of the boat with the boiler on the opposite side and was built by Fleming and Humbert of St. John. She was a side wheeler also.

One of the earliest steamers was the "St. John" built at East St. John. She was a side wheeler. The engine was built by John Smith. Captain Retallick says it, (the reciprocating part of the engine), looked like a saw mill gate or sash moving up and down. This boat was launched under steam and managed to paddle around into St. John Harbour under her own power, but the hull was so full aft, that she would not steer. Later, after a new stern was added, making her about 24 feet longer, she worked satisfactorily.

George Fleming of Dysart, Scotland, who served his apprenticeship at Dunfermline, grandfather of the present owners of the Phoenix Foundry and Locomotive Works, established at St. John in 1835, and built quite large marine engines for service on the St. John River, Bay of Fundy, and later for the Prince Edward Island service—two of these boats, the "Rothesay" and "David Weston" for river service were famed all over Canada for their speed. The old records of the Company show that Mr Fleming supplied an engine to Brazilian Ansley in 1838, price 250 pounds, and in 1840 an engine and malt mill for 225 pounds and an engine for George Younger, price 180 pounds The Flemings are said to have built the first steam fog whistle used in any part of the world, which was designed by a St. John man, and was placed on Partridge Island, St John Harbor.

In the early sixties and seventies, a number of well known engineering concerns in the Maritime Provinces built stationary steam engines for the many large saw mills in New Brunswick and Nova Scotia, as well as for factories, mines and various other purposes. Among the most prominent of these may be mentioned, Geo. Fleming & Sons, John Smith, Harris & Allen, and Allen Brothers of St. John. The Pictou Foundry, established by Mr. Davies Sr., in 1854, who came from the old country as Master Mechanic of the General Mining Association—I. Matheson, formerly located at Chatham, N.B., and later at New Glasgow, and his son W. G. Matheson. The Truro Foundry and Machine Company. The Burrell Johnson Iron Works of Yarmouth, N.S., which built tug boats and small steamers, marine engines of considerable size, Waterworks engines, etc., The Montgomery Iron Works at Halifax and Moir Symonds. The Montgomery company built a few locomotives which were used on the Intercolonial Railway.

From 1885 to 1890 the use of electric power for lighting, tramways and other purposes began to develope extensively in the United States and to some extent in Canada. Among the first to forsee and take advantage of the increasing demand for improved high speed engines, suitable for driving electric dynamos direct from the engine shaft, was the Robb Engineering Company of Amherst, N.S. This concern, working in collaboration with the General Electric Company, Westinghouse Company and other manufacturers of electrical apparatus, succeeded in producing combined steam engines and electric machines in compact form, adapted to the various services for which electricity was required. The first of these engines was designed and built by the Robb Engineering Company at Amherst, N.S., in 1890-91 under the direction of E. J. Armstrong, who was a pupil of the late Professor

John E. Sweet of Syracuse, New York, one of the best known designers and builders of high speed engines and a great educationist in mechanical engineering.

Mr. Armstrong was able, during the few months he spent at Amherst, through his thorough knowledge of the inter-changeable system used in building high speed engines and his natural ability as a draftsman and shop instructor, to organize a department of the Robb works so that they were able to build, with Maritime Province boys, engines for electric service which were equal to the best produced in the United States or elsewhere. He also enabled this Canadian shop to develop its own steam engineering and drafting departments in which engines were designed and supplied for electric work, not only throughout Canada, but, being among the first in this field, was able to furnish engines of this type to Great Britain, Spain, Australia, India, South America, British Guiana and several of the West India Islands. The exceptional compliment was paid to these works of receiving an order for a compound electric engine for use and educational purposes in the Manchester Technical School at Manchester, England.

The steam turbine has to a considerable extent, supplanted the reciprocating steam engine for large electric units where steam furnishes the motive power. Oil and gas engines are making considerable headway for the smaller units and to some extent for marine use.

The tremendous development of water powers in Canada has also restricted the use of steam engines for electric production, but as yet the marine field is to a very large extent held by the steam engine. In passing it will no doubt be of interest to mention that the triple expansion engines to be installed in Nova Scotia's two largest ships, 8100 tons each, were built at Amherst One of these ships the "Canadian Mariner" was launched from the Halifax Shipyards on the 4th of September and the other is well advanced in construction.

There is no doubt that steam engines will continue to be built and used for ship propulsion for some time to come, or until the rapid changes constantly taking place in engineering construction bring forth something better or more efficient and economical.

S. S. "Canadian Runner" Built by Port Arthur Shipbuilding Co. (See September issue).

A MODERN PLANT FOR MINING, CONCENTRATING & SMELTING MAGNETITE FORTY MILES FROM NEW YORK.

Lean Siliceous Ore of 36 per cent Iron Content.

An iron-ore mining enterprise of significance to Canadian readers as bearing upon some much debated problems of the utilization of magnetite, is that of the Replogle Mine near Wharton, New Jersey, which is described at length, with many illustrations, in the "Engineering & Mining Journal" of 2nd October.

The ore is described as lean, and high in silica, running about 36 per cent iron. It is being concentrated, first in a dry mill by magnetic separators, and the tailings by tables in a wet mill. At Wharton, two new blast furnaces are being built with a capacity of 500 tons of pig iron daily from each furnace.

New Jersey in 1882 produced 920,000 tons of iron-ore, but the industry has decayed owing to competition of lake ores. Increased cost of carriage from the lakes and the improved methods of concentration now available are tending to revive magnetite mining.

The deposit controlled by the Wharton Steel Co., which owns the Replogle Mine, is estimated to contain 27 million tons of ore, as proved by diamond drilling. About 875 to 1,000 tons of crude ore are being crushed daily. The ore body is described as a lens of magnetite in gneiss, without definite contact between the magnetite and the gneiss, there being a gradual change from one to the other. The installation of the wet mill was made necessary by the occurrence of martite (Fe_2O_3) intimately mixed with the magnetite, which makes a portion of the ore non-magnetic and not susceptible to the magnetic separation process used in the dry mill.

A sintering plant of 800-900 tons per 24 hours capacity is being erected, intended to sinter a portion of the concentrates, mixed with flue dust from the old furnaces, of which a considerable accumulation is available. Lime for fluxing is being obtained from Ogdensburg, N. J.

The article describing the Replogle Mine is by A. H. Hubbell, and it is interesting in Canada because of the somewhat parallel conditions of ore occurrence. The Replogle Mine has, however, the advantage of being close to an industrial centre, being about forty miles from New York.

NEW PRESIDENT FOR HALIFAX SHIPYARDS, LTD.

Announcement is made that H. B. Smith, President of the Collingwood Shipbuilding Company, Limited, and a director of the Canada Steamship Lines, has been made President of Halifax Shipyards, Limited succeeding Roy M. Wolvin, who has retired owing to the pressing duties of his position as President of the Dominion Steel Corporation. Halifax Shipyards is one of the chain of shipbuilding companies slated to enter the British Empire Steel Corporation merger, and it is said that Mr. Smith will be the shipbuilding director for the big corporation's chain of yards on the Canadian waterways.

A copy of Bulletin 9-B of The Electric Furnace Company Alliance, Ohio, is to hand. It is a new catalogue describing fully the Baily Electric Furnaces for melting non-ferrous metals, also for treating and annealing. The catalogue should prove of interest to the Iron trade in general.

COMPANY NOTES

Baldwin's Limited Commence Rolling of Tin Plates at Toronto.

The first of the eight tin-plate rolling mills which are proposed to be installed at the Ashbridge's Bay, Toronto, plant of Baldwin's Limited was given a trial run on the 28th September, and was started for commercial operation on October 4th. The opening of the plant took place exactly a year from commencement of construction.

At the initial run on the 28th, a number of Toronto ladies were invited to start the mechanism, which is all electrically driven and controlled. On the 4th the families of the 500 workmen which the mill will employ in its present stage were invited to a general opening, and again the rolling processes were undertaken by ladies.

The General Manager, Mr. S. R. Cound, showed the guests the successive rolling and tinning processes. Mr. Cound stated that the employees would be increased to 1,000 within six weeks, and that the ultimate scale of the plant proposed would employ five thousand workpeople. The President of the Canadian branch of Baldwin's Limited is Mr. A. M. Russel, and the Secretary of the Company, Mr. R. S. Smith.

A feature of the works is the number of Welshmen who have come from the home works, and the special nature of the opening was marked by the singing of Welsh airs and the traditional musical features of any gathering where Welshmen predominate.

Canadian General Electric Company Consolidates with Marconi Company of Canada.

The Marconi Wireless Telegraph Company of Canada announces its affiliation with the Canadian General Electric Company, and prominent directors of the Electric Company have taken seats on the Board of the Marconi Company, namely, Senator Nicholls, Sir William Mackenzie and A. E. Dyment, all of Toronto.

Plans involved in the reorganization of the Marconi Co. which now comes under Canadian direction call for additional capital for the exploitation of wireless patents controlled by the Electric Company. Recently a consolidation of the wireless interests of the American Marconi Company and the General Electric Company of America was effected, which gave unified control of wireless patents to a new company, the Radio Corporation of America, but Canada was not included in this consolidation as the Canadian General Electric Company is not under control of the General Electric Company.

The Canadian General Electric Company is an organization of growing strength and importance in Canada, and is progressing naturally with the growth of Canada and the ever-increasing application of electricity to the arts. The new and influential interests which are now conjoined with the Company will still more increase its activities and general importance.

Annual Report of the Canadian Locomotive Co.

The Annual Report of the Canadian Locomotive Company was presented at the Annual Meeting at Kingston on September 16th, and showed net profits amounting to $278,553, compared with $848,383 in the preceding year.

The Chairman of the Board, Mr. Aemilius Jarvis, stated :

"The strike of last year extended to this year, completely cutting off our production for the first three "months. This together with the great difficulty in "securing material owing to strikes and embargoes on "American railways has affected our output for the "past year very materially. However, we have at "the present time sufficient contracts on hand to run "us up to January 1, 1921, before which time undoubtedly further contracts will be closed."

According to the statement presented, the profits year by year for the past nine years have averaged $492,608 and have been as follows: 1912, $326,380; 1913, $396,886; 1914, $342,057; 1915, $134,613; 1916, $574,211; 1917, $721,254; 1918, $677,937; 1919, $892,976; 1920, $367,959.

Following are the principal items from the report, with comparisons :

	1920.	1919.
Net profits	$278,553	$848,683
Int. from invest.	89,415	44,292
Total	$367,969	$892,976
Bond interest	90,000	90,000
Replacements	25,000	25,000
Depreciation	100,000	100,000
Reduce invest to market val.	21,000	......
Loss on sale of invest.	22,779	598
Total ded.	$258,779	$215,598
Balance	$109,189	$677,377
Balance forward	1,366,794	929,417
Total	$1,475,983	$1,606,794
Sinking fund	15,000	15,000
Preferred dividends	105,000	105,000
Common dividend	145,000	120,000
Balance forward	1,210,983	1,366,794
Current assets	2,630,189	2,298,430
Current liability	1,077,134	633,754
Total assets	8,238,192	7,871,474

Dominion Steel Co. vs. the Government in the Exchequer Court.

The point at issue is the price the Dominion Steel Company shall be paid for 116,000 tons of rails rolled and delivered subsequent to April 1918, by the steel company, the rails being furnished in consequence of an order-in-council passed by the Government under the authority of the War Measures Act enjoining the company to supply at least one hundred thousand tons in order that the railways might be put in a position to operate up to full capacity during the period of the war.

The cause of the difference of opinion as to the value of the rails, was that when the Government order was issued the Dominion Iron and Steel Company had in hand large orders from the Imperial Munitions Board for shell steel, and the manufacture of this had to be practically discontinued, with the result that 99,000 tons were not delivered. On behalf of the company it was stated that for this steel the company would have received about eighty dollars per ton, but cost of production would have exceeded the cost of making rails by from three to five dollars per ton. The company suggested in view of these facts that it should receive $75 per ton for the rails. The War Trade Board, on the other hand, took the view that $65 would be a proper price. The company refused to ac-

cept this price when it was offered by Hon. J. D. Reid, Minister of Railways, and in accordance with the terms of the original order-in-council, a reference was made to the Exchequer Court. The amount actually in dispute, therefore, is $10 per ton on 116,000 tons, or $1,116,000. Of nearly eight million dollars claimed by the company for the rails, some $5,500,000 has already been paid by the Government.

The plea of the Steel Company is that it shall be placed in as good a position financially as it would have been had it been permitted to proceed with its contracts with the Imperial Munitions Board, and other contracts which would have been undertaken but for the Order-in-Council. The case is proceeding ,and argument of counsel will be heard on Oct. 25th.

Dominion Steel's Production Cost affected by Increase of Miners Wages.

Mr. Wolvin, President of the Dominion Steel Corporation, recently stated that a profitable market had been found during the current year for the Corporation's steel products in the British market, but unmistakable evidences were now present that serious competition from Continental European sources was likely. Belgium had more than recovered her prewar capacity for iron and steel production, and was offering material in the British markets at prices which had caused a softening in the markets. For several weeks the Dominion Corporation had been unable to make any foreign sales.

Mr. Wolvin stated that any increase in the cost of coal production would seriously hamper the Steel Company's ability to market its products, and pointed out that a increase of one dollar per ton in the cost of coal meant an increase of four dollars per ton in the cost of finished steel. The cost of coal production was now so high that any increase would jeopardize the Company's position in the markets it was seeking to cultivate. The recommendations of the Royal Commission as to further increases in wages, if followed, will of course have the effect forecasted by the President.

Mr. Wolvin did not make any statement on the Company's attitude on the Royal Commission's findings, stating that as these were not approved by the men, this was not necessary. It may be mentioned that the award of the Royal Commission will mean, approximately, an increase in wages of one dollar per day to each colliery employee, which, applied to the cost of coal production on the present rate of output and number of workmen, will add from 60 cents to a dollar per ton.

The visit of Mr. Wolvin to the iron-ore mines at Wabana is in connection with the resumption of export trade in iron ore, but there is a possibility that through the export connections associated with the British Empire Steel Corporation a resumption of overseas shipments from Wabana may take place in 1921. There is no limit to the extent of the export trade that is possible from Wabana except that of markets, as the ore is obtainable in any quantity desired should development of additional openings be undertaken, either by the Dominion or Scotia companies, or both.

Nova Scotia Steel & Coal Company Working at Capacity.

The works of the Nova Scotia Steel & Coal Co. are working at capacity, and have orders on hand which will keep production at a maximum for the best part of the winter. A better rate of production, and greater efficiency has marked operations in recent months. The car works fully employed with about 700 workmen, and satisfactory deliveries are being obtained both of incoming material and finished cars.

The steel-workers at Sydney Mines have passed a resolution in favor of a general eight-hours day in steel plants, but in doing so have recognised the difficulty of small plants in Canada in adopting a practice that is not followed in the United States.

The resolution reads : "That a special effort be made to establish a work day of not more than eight hours in each twenty-four, and to that end the co-operation of the officials of the steel companies in Nova Scotia be sought to bring about a universal eight hour workday on each of the steel works on the North American continent.'

Lake Superior Corporation's Annual Statement.

The Annual Statement of the Lake Superior Corporation for the year ending June 30th 1920 shows income from subsidiaries as under :

Company—	1920	1919
Algoma Eastern	$ 247,098	$ 206,846
Brit.-Amer. Express	3,727	2,336
Fiborn Limestone	6,386	18,966
Cannelton Coal	186,960	107,057
Lake Superior Coal	125,721	67,875
Algoma Construction	....	1,780
Algoma Steel	3,147,695	5,035,032
Sault Ste. Marie	4,564	1,679
	$3,722,152	$5,441,574

The production of the Algoma Steel Corporation, the main subsidiary, was as under:

	1919-20	1918-19
Coal imported	642,680	880,591
Ore imported	525,708	700,510
Limestone produced	242,414	296,812
Coke	441,125	406,398
Pig iron	299,892	336,657
Steel ingots	314,358	414,932
Finished steel	243,737	322,011

The sums set aside for depreciation and sinking fund were smaller than in the previous year, and the policy of the Board in not paying dividends enabled a larger sum to be carried forward to reserve as shown by the following figures :

	1920	1919
All companies	$3,722,152	$5,441,574
Forward	x1,479,470	668,293
Adjust. dep.	....	218,694
	$5,201,622	$6,328,561
Bond interest	$1,315,522	$1,235,710
Dividends	180,000	1,054,000
Reserves	....	625,000
Gen. deprec.	1,024,964	1,500,000
Sinking fund	88,898	324,463
Carried forward	2,592,237	1,589,388
	$5,201,622	$6,328,561

x Less taxes.

With regard to the other subsidiaries, the President statements may be summarised as follows The Cannelton Coal & Coke Company produced 636,792 tons as compared with 580,737 tons in the previous year. Operations were hindered by the miners' strike and shortage of railway cars. The Lake Superior Coal Co. produced 222,799 tons compared with 224,375 tons in

the previous year. Both the coal companies have prospects of good winter markets at favorable prices. The result of operations on the Algoma Eastern and on the Algoma Central and H. B. Railway was affected by high labor costs. The Algoma Eastern shows a surplus of $11,627 compared with a deficit in the previous year of $31,076. The Algoma Central showed a deficit, before bond interest, of $169,071. Relief from the unprofitable operation of the railways under present high costs of labor and material is hoped for from increased railway rates allowed.

At the annual meeting of the Corporation, held at Camden N.J., on the 7th October, President Franz of the Algoma Steel Corporation expressed his view that the outlook, both for the steel company and the railways was very hopeful He did not anticipate any decline in the price of steel, especially rail steel. He also stated that the Algoma Company had gone extensively into the manufacture of high-grade alloy steels, which is now used extensively in the manufacture of motorcar parts. The Company was finding a good market for this product.

Electric Steel & Metal Co., Welland, Discontinue Operations.

The Electric Steel & Metal Company of Welland discontinued operations at the beginning of October. This Company, incorporated in 1913, completed the installation of its electric-furnace steel-foundry in the Spring of 1914, and when the war commenced was in a position to provide shell blanks and shells. During 1917, the Electric Steel & Metals was consolidated with the Boving Hydraulic & Engineering Co. of Lindsay, and the Wabi Ironworks of New Liskeard, under the name of Electric Steel & Engineering, which controls the three subsidiaries from the head office at Welland. After the Armistice, the Electric Steel & Metals Co. equipped the foundry for forging ingots and steel castings to the extent of 300 tons of castings and 700 tons of forging ingots monthly, and its products were well and favorably known for their high and unvarying quality. Mr. G. C. Mackenzie, the General Manager, states that unfavorable conditions of the market, and the outlook have decided the officers of the Company to discontinue production at the Welland plant.

The discontinuance of work at Welland will not affect the Lindsay or the New Liskeard plants.

The Welland Plant has two 7-ton Heroult electric furnaces, and it is with regret that we note a still greater reduction in the quantity of electic steel produced in Canada. In 1918, 115,854 tons of electric-steel ingots, and 11,520 tons of electric-steel castings were reported in Canada. In 1919, this had dropped to 8,741 tons of ingots and 6,761 tons of castings. The production of electric steel in 1920 promises to go back to pre-war figures.

Delaney Iron & Forge Co. sold by Canada Foundries & Forgings.

Pursuant to authorisation by the shareholders at a meeting held in Brockville on September 28th, the sale of the properties of the Delaney Iron & Forgings Company of Buffalo has been arranged. Unofficial reports state that the price is $500,000. The Buffalo plant was acquired by the Canada Foundries in 1917, and it is understood transfer is to take place within sixty days from the date of authorisation by the shareholders.

Toronto Syndicate control Levaud System of Iron-Pipe Manufacture.

It is announced that a Toronto syndicate have secured the rights for the entire world of a new process that will revolutionize the manufacture of iron piping. The inventor is Senor de Levaud, who was in Canada some little time ago, when his invention was brought to the attention of Sir Henry Pellatt, Gordon F. Perry, President and General Manager of the National Iron Corporation, Limited, and Mark Workman. After thoroughly investigating the process they formed a syndicate and obtained control of the rights.

It was stated by Mr. Perry that the process was the greatest step forward in the industry since the commencement of the manufacture of iron piping and already it has revolutionized the industry. The National Iron Corporation of Toronto has been operating the process for eighteen months and it has been found that the production has been increased in the ratio of five to one compared with the previous system of manufacture. The new process is entirely new and permits the manufacturing of iron piping that is much lighter than that made in the old way, but is yet much stronger. The process is said to eliminate the imperfections common to the ordinary cast-iron pipe. As a result of the new system the number of operations in the manufacturing of piping is reduced from thirty-one to four, and this calls for very much less plant and gives greater production.

In Canada the process is controlled by the National Iron Corporation, Limited, and the rights for the British Empire, exclusive of Canada, have been obtained by the Stanton Iron Works, Nottingham, England, the largest manufacturers of iron piping in the World. The manufacturers of piping in other countries have taken it up so that now the process is in general use.

The Toronto Iron Works, Limited, have just completed an addition to their plant at the foot of Cherry Street, Toronto, which is to be used as a machine shop. The new addition is 40 x 140 feet and is built chiefly of steel. Other completed improvements are wash and luncheon rooms for the employees, the whole involving an outlay of about $15,000. The Company proposes further expansion and improvements for next season.

Imperial Steel & Wire.

Operations have been commenced on the new factory of the Imperial Steel & Wire Company at Collingwood. Lt.-Col. J. A. Currie, president of the company, states that the new buildings will be much larger than those destroyed by fire in May, 1919, while the plant will be expanded so as to give an output of about 200 tons of wire products per day.

INCORPORATIONS

Toronto.

The Sanitary Sheet Metal Containers, Ltd., has been incorporated to manufacture sheet metal, cans, etc., with a capital stock of $250,000, by Frank Regan, 12 Richmond street, east, John Callahan and others.

The American de Levaud Mfg. Co., Ltd., has been incorporated to manufacture cast iron, steel, pipe, tubing, etc., with $7,500,000 capital, by Francis A. Blackburn, 93 Lonsdale road; John R. Phippen and others.

Montreal.

The Airtight Valve Co., Ltd., has been incorporated with a capital stock of $3,000,000, by Richard T. Heneker, Henry W. Chanvin and Harold E. Walker.

Windsor.

The Dominion Motor Castings, Ltd., recently was incorporated with a capital stock of $250,000 by Clifford A Ripley, Frederic Skellenger and Adolph Janda.

Port Arthur.

The Port Arthur Structural Iron Works, Ltd., has been incorporated to manufacture structural material, etc., with $100,000 capital, by Alexander J. McComber, Wallace A. McComber and others.

Walkerville.

The Canadian Detroit Twist Drill Co., Ltd., has been incorporated to manufacture twist drills, etc., with $20,000 capital, by Alexander R. Bartlet, George A. Urguhart, Andrew Braid and others.

Capital Increases

The capital stock of the Burlington Steel Company, Limited, has been increased by Ontario Letters Patent from $20,000 to $200,000 by the creation of one thousand eight hundred shares of stock of one hundred dollars each.

The Ontario Steel Products Co., has been granted permission to increase its capital from $1,500,000 to $2,750,000.

The Canadian Atlas Crucible Steel Co. Ltd., Locate at Welland.

The Plant of the Dillon Crucible Alloys, Limited, Welland, has been purchased by the Canadian Atlas Crucible Steel Co. Ltd., and Canadian interests will be strongly represented in the Company as well as on the Board of Directors.

Atlas products, which include the well known "L-XX" brand of high speed steel and other Atlas brands of best quality, carbon and special alloy tool steels, will now be made in Canada.

There will now be produced in Canada with Canadian Workmen just as good tool steel as can be produced in England or United States, and the cordial good will and support of the Canadian trade is expected.

The General Sales Office of the Company will be located at 133 Eastern Ave., Toronto, with a warehouse in conjunction, and branch warehouses and Sales Offices at 326 Craig St. W., Montreal, also at Winnipeg.

VANCOUVER SHIPYARD METAL WORKERS ASK $8.00 PER DAY

The plumbers, steamfitters, and sheet-metal workers engaged in the pipe-shops of Messrs. Coughlan and Wallace Shipyards, have struck for eight dollars a day wages. It is very evident that the shipworkers in Vancouver are poor hands at reading the signs of the times, and the present time is a most inopportune one for such a drastic action. Such ill-advised action has had most unfortunate consequences in other Canadian shipyards.

OIL FUEL SUCCESSFUL ON "EMPRESS OF BRITAIN.

On the first oil-burning trip of the "Empress of Britain" Rear-Admiral S. W. Roome, Chief Superintendent Engineer of the C. P. O. S. said the vessel made an average of 18.56 knots during the voyage, a very fast record. Crude oil was used to the extent of 1,453 tons, which compares with 1,800 tons of coal when using the old system. Boiler pressure was maintained at 220 lbs. through the trip. The number of stokers using coal was 120, but with oil fuel only 27 attendants were needed.

On the main staircase of the "Empress" is an interesting memorial plate, detailing this vessel's record as flag-ship of the North Atlantic merchant patrol during the war, when she was known as the "Alsatian". The most impressive figures on this record are those that relate to the ton of coal consumed on this service.

MR. T. J. DILLON, CANADIAN ATLAS CRUCIBLE STEEL CO.

Mr. Thomas Joseph Dillon, of the Canadian Atlas Crucible Steel Company, which recently took over the Dillon Crucible Alloys, Limited, of Welland, is widely known in the iron and steel trade of Canada, largely through his official connection with the Canada Forge Co., Limited, of Welland, and Canadian Billings & Spencer, Limited, of which concern he is general manager. Born in Indianapolis, he received his early industrial training in the plant of the Titusville Forge Co., Pennsylvania, where he worked in every department and learned the business, becoming a forging specialist in 1905. In that year he came to Canada and organized the Canada Forge Co. of which he was president, building the enterprise up to its present magnitude. This organization was bought out by the Canada Foundries and Forging Co. in 1912. Mr. Dillon becoming one of the directors. During the

T. J. DILLON.

early period of the war he was one of a small group who demonstrated that shells could be made in Canada of as good quality as anywhere else. He is a keen business man, and in the Niagara District and in iron and steel circles generally he is looked upon as a good fellow. Among his other activities, Mr. Dillon is President of the Stanford Steel Construction Co. of Port Robinson.

THE MOOTED IRON AND STEEL INDUSTRY IN BRITISH COLUMBIA.

Evidence Before the Tariff Commission.

In the last few weeks there has been much talk and the indications are that there will be some action with regard to the establishment of an iron and steel industry in British Columbia. For some time H. A. Fleming, president of the Canadian Collieries (Dunsmuir), Limited, has been in the Province investigating local conditions with respect to the iron resources of the country and the market that may be relied upon for such a Pacific Coast enterprise. Recently he interviewed Honorable William, Sloan, Minister of Mines, in regard to the assistance that might be expected from the Government in the event of his company entering upon the enterprise. Messrs. Sloan and Fleming went thoroughly into the matter and subsequently Mr. Fleming issued a public statement the purport of which was that he felt convinced that conditions were opportune for making a start along the lines indicated. He said that he was leaving for the East, and would take immediate steps to get the matter forward. It was his hope that within a short time it would be possible to make a definite announcement. Following this, Mr. Sloan made the statement that it was satisfactory to know that Mr. Fleming had found conditions right, but that the result was not unexpected as the researches which had been carried out by officials of the Department of Mines in the last three years have shown conclusively that British Columbia possesses iron ore of the highest grade and in adequate quantity for the establishment and maintenance of a plant capable of a large daily output.

Mr. Sloan significantly concluded:—"It is pleasing to have Mr. Fleming support the position we have taken in this respect, and to know that with the assistance the Provincial Government is prepared to extend to the industry, a course will be recommended to each company which he expects will lead shortly to a definite announcement by the Government of great importance to this Province."

The foregoing incidents occurred after it had been announced from Vancouver that Nichol Thompson, a prominent resident of that city, who for some time has been interested in the promotion of an iron and steel industry for his province had appeared before the Tariff Commission, now touring the Dominion and had there given evidence that there exists on the Pacific Coast a market up to 1,500 tons a day for iron and steel manufactured in British Columbia. It was stated by Mr. Thompson that he had reliable information on which to base this assertion, having just completed a tour of the Coast, made for the special purpose of inquiring into these particular market conditions. Mr. Thompson urged that in the interest of mining in this Province the tariff existing on drill steel before the war should be continued. This permitted free importation of steel costing more than 3½ cents per lb.

Talking about his experiences while on tour, Mr. Thompson affirmed that there existed a daily demand of from 1000 to 1500 tons, of pig iron.

British and also American capital was interested in the possibilities of such an industry, and British engineers were expected before long to further investigate. There was no question that the ore deposits existed here. There were such deposits at Texada Island, Redondo Island and Smith's Inlet. Pig iron was sold locally for about $65.00 a ton, the same price as that in the Seattle market. The steel and pig iron used on the Coast had to come from Pittsburg and other eastern points.

Sir Henry Drayton:—"Then so far as the west is concerned you have to stand for that long haul from Pittsburg to Ontario."

Mr. Thompson:—"Yes".

In answer to further inquiries Mr. Thompson explained that 20,000 tons of Texada Island ore had been treated at Irondale, in Washington, and that it had been used in conjunction with other ores in the manufacture of steel for two United States warships. The latter method had proved that the ores of British Columbia could be used to produce iron and steel without importing fluxing ores. The difficulty which had retarded production in the past had been the market.

Sir Henry:—"Assuming that you have the market and you have the ore, what could be done to get production in Canada?

Mr. Thompson intimated that in the past Eastern firms had been assisted financially by the government.

"Then I take it that you wish to get a bounty on ores?" asked the chairman.

"Yes, either on ores or the finished product. I do not favor bounty of the treatment of imported ores, just local ores," answered Mr. Thompson.

Sir Henry:—But the system of bounties was done away with some years ago.

Mr. Thompson:—But assistance was given to eastern plants.

Sir Henry:—By the giving of contracts. I may say, however, that the government has made money from those contracts, having sold the steel for more than it bought it for, shipping to Britain and Australia. If we were to rebate duties on machinery and equipment for iron smelters and plants, would that be sufficient?

In view of these developments those who are interested in seeing this great basic industry launched in British Columbia are hopeful that there will be some real action within a considerable lapse of time. There is this to be said regarding the possibilities of the Canadian Collieries becoming interested, namely: with its large coal lands on Vancouver Island; its coking facilities near Cumberland and the substantial investment it has in the way of plant, etc., there is no concern more favorably placed for entering upon such an individual enterprise.

STRUCTURAL STEELWORKERS WAGES DISPUTE COMPROMISED IN TORONTO.

A settlement of the differences existing between the Structural Steel Workers' Union and the steel erecting firms in Toronto has been effected and the men returned to work on Sept. 22nd. The terms of the settlement were not stated. With the settlement of the dispute work will be resumed on the several large buildings in Toronto which was interrupted some weeks ago when the strike was inaugurated. The work has been stopped when other building trade mechanics had caught up with the steel erected by the steel workers before they went on strike.

TORONTO BRANCH, CANADIAN ASSOCIATION OF BRITISH MANUFACTURERS, GIVES GOOD ADVICE TO OVERSEAS BUSINESS HOUSES.

The "Board of Trade Journal" quotes from the "Sales-Craft" Bulletin of the Toronto Branch of the Canadian Association of British Manufacturers as follows, and commends the criticisms of this Bulletin on British methods of trading and credit terms to the careful consideration of overseas firms who desire to do business with Canada:

"The following extract recounting the experience of a Canadian manufacturer is reproduced here in the hope that firms on this side will give closer consideration to the question of terms when treating with overseas business houses of good financial repute and standing:—

Unjustifiable Trading Terms.

"A Canadian manufacturer of steel and iron products recently had occasion to replenish his stock of certain materials used in various articles manufactured in his mills, and as there were only two sources of supply, Great Britain and France, and the producers few in number, the business was offered to a United Kingdom manufacturer. A natural preference in the matter of trading, national bias in conjunction with Imperial sentiment, prompted this loyalty to British enterprise. The offer, as many another prospective Canadian purchaser has been forced to testify, was not met in kind, the intending customer being informed that the order could only be undertaken on the basis of 'cash with order" or by the instituting of a ' letter of credit " with a London banking house to the order of the United Kingdom manufacturer. Such stipulations were, and are, quite out of the question, as no responsible Canadian business house will consent to do business under those conditions nor submit to dictation of trading on terms of that nature. The result of the matter was the booking of the order by a French manufacturer on open account at sixty days' dating.

"Hence for ten years past this business, though offered repeatedly to a British manufacturer and more than once to the same house, has been executed in France. There is no question as to financial standing of the Canadian firm, it is quite good and annually improving, the firm buying largely in the United States, but nothing in England.

" In a recent conversation, the head of the business expressed an opinion, that is in no sense isolated, that United Kingdom manufacturers and business houses can expect no great extension of trade in this country until they accredit to Canadian business men a measure of integrity beyond that of a band of robbers. In this one instance orders amounting to practically $50,000 have been lost to British mills merely on a question of terms of sale."

Canadian Demand for Steel Products.

This issue of the "Bulletin" is intended to urge upon United Kingdom readers and correspondents — the manufacturers of iron and steel products — to make a careful and introspective study of the situation in relation to the consumption of steel products in Canada, other than those of domestic manufacture, and the two main sources of this supply, the United Kingdom and the United States.

The magnitude of this consumption is revealed by a perusal of the Customs returns for several decades, and particularly of those imports covering the period of 1913 to 1920. The figures form a quite instructive study and are very illuminative of the potentialities of Canadian trade viewed from the standpoint of the United Kingdom manufacturer, if properly, intelligently, and energetically catered for.

In 1883 manufactures of iron and steel exported to Canada from United States sources were, practically, upon an equal footing, the total for that year amounting to $6,723,258 and $6,897,492 respectively. During the next decade they remained upon a somewhat equitable parity, fluctuating by merely a few hundred thousand dollars annually from one side to the other. But in 1893 American exports exceeded those from Great Britain by $1,173,700, and from that date to the present the consumption of American manufactures of steel in Canada exceeded the exports from Great Britain by the stupendous sum of $139,502,302.

American and British Exports.

To illustrate, the figures for the past seven years are submitted for consideration :—

Year.	Steel Imports from U.K. Dols.	Steel imports from U.S.A. Dols.
1913	10,394,276	106,471,913
1914	10,132,543	85,729,001
1915	7,402,894	55,462,477
1916	3,950,000	71,459,771
1917	4,683,103	119,754,365
1918	4,081,681	154,113,633
1919	5,912,768	154,426,648
1920	5,167,100	144,669,402

These figures cover the whole of the imports in manufactures of iron and steel, and of which some of the more important items are as follows :—

Product.	From U.K. Dols.	From U.S.A. Dols.
Agricultural implements	10,102	4,934,055
Angles, channels, beams	4,060	5,506,343
Axles and axle parts	3,103	2,023,778
Bars, bands and hoop scroll	1,310,379	10,059,372
Bar, iron or steel, rolled	2,768	3,211,132
Bar steel for manufacture of shovels	....	265,935
Malleable iron castings	....	566,636
Iron castings	....	1,331,632
Traction engines and parts	....	15,333,791
Angles, knees, masts, etc. (for ships)	246,803	6,831,681
Wire	329,319	3,781,507
Miscellaneous articles not otherwise classified	149,996	10,914,113
Automobiles	8,134	11,196,327
Motor trucks	19,945	3,811,139
Motor cycles and motor vehicles	6,030	420,575

Causes of American Increases.

The "Bulletin" claims that it is not altogether, neither is it very largely, as some exponents of the balance of trade would have the United Kingdom manufacturer believe, a matter of geographical position and contiguity of territory to that of the American Republic across the entire width of a vast continent. It is more largely a matter of methods and means. It is the purpose of this "Bulletin" in its issues from time to time, to explain the difficulties and lay bare the facts, so that British industry, by an examination of method and, in numerous instances, a revolutionary adaptability to extraneous conditions, may secure a

more adequate share of the consumption of manufactured products in this country. It was for just this purpose that the Canadian Association of British Manufacturers and their Representatives was formed.

Canada's Increasing Consumption.

Canada's importations of manufactured goods and raw materials have, during the past decade, represented a vast and annually increasing volume, the year recently ended showing a large increase in our foreign purchases amounting to more than $76,000,000 in excess of the previous year, and the returns for the first two months—April and May—of the present fiscal year show still further increases in the influx of goods from beyond the national boundaries. In the latter month total imports amounted to $113,447,899, an increase over May, 1919, of $42,103,000 the larger volume of which entered from the United States, Canadian buyers seeming nothing daunted by the high adverse rate of exchange, which, as between the value of English and American money in this market at the time, amounted to approximately 26 per cent.

Total imports for the past two fiscal years ending with March 31, 1919 and 1920, amounted to $916,429,335 and $993,870,100 respectively. And of the first of these large sums, the last for which there are fully completed returns, the United States furnished $416,457,384, in manufactured and dutiable goods and $330,443,270 in raw materials, the United Kingdom $50,008,008 and $23,027,110 respectively.

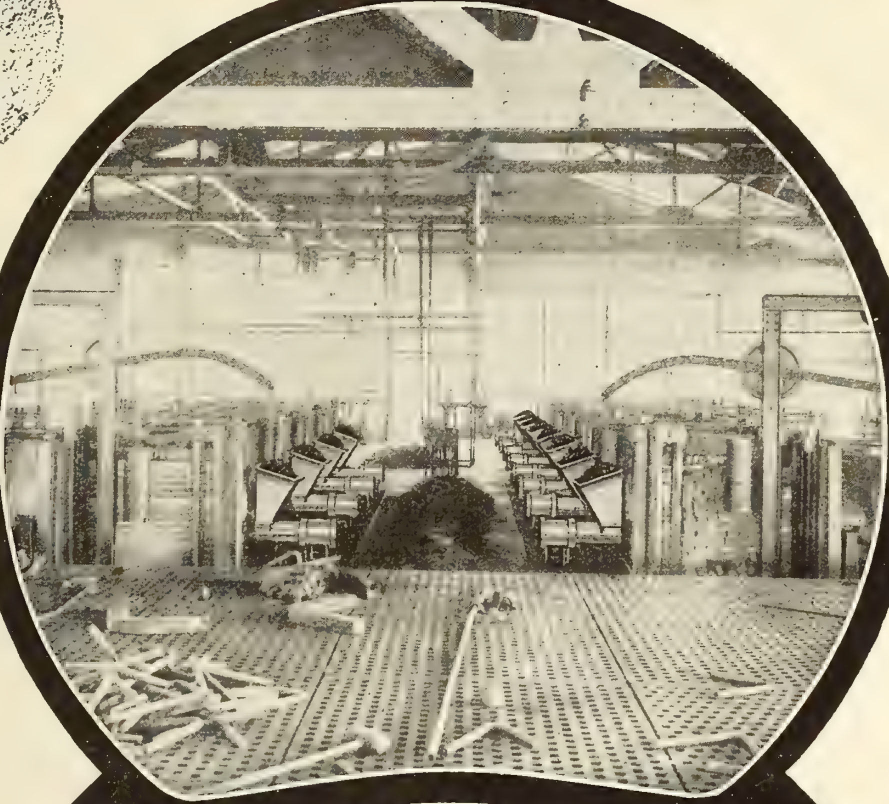
WORLD DEMAND FOR STEEL.

There will be some surprise that American steel exports in July were so large in view of the transportation and labor handicaps in that month. As indicated elsewhere in detail, the July total was 489,223 gross tons, which is not only the largest amount for any month this year, but also for 1919, with one exception. The nearest approach this year was 420,359 tons in May, while the lowest record was 308,185 tons in February. Imports also showed a healthy increase, having been over 100,000 tons larger to August 1 this year than to August 1, 1919.

Not only were American steel exports the year's maximum in July, but those from Great Britain were also, as pointed out one week ago. The combined British and American steel exports for July afford a measure of the world's present demand for steel as compared with 1913. The month's total for the two countries was 882,239 tons, or the largest for one month in many years, if it has ever been equaled. In 1913 British exports averaged 420,457 tons per month, and those of the United States 228,803 tons—both records to that time. The world's demand on the two countries in 1913, including shipments between the two, was 649,650 tons per month, or much less than their combined exports last July. With Belgium and France doing little in exports, and Germany out of the reckoning, while Russia and Austria are no longer factors, the non-producing countries must depend on American and British sources of supply.

These figures are not only impressive, in view of financial and economic conditions the world over, but they are prophetic of what the world's needs may be when times are more normal.—"Iron Age".

Uniform Furnace Heat With Low Fuel Cost



Twelve Jones Stokers Installed in 35-ft. and 60-ft. Heating Furnaces

Industrial Heating Furnaces fired with Jones Under-Feed Stokers have uniform furnace heat under all conditions. Operation of stokers is automatic. No doors to be opened —no chilling drafts through furnace. Temperature can be closely regulated and held within close limits.

Combustion is complete so that coal cost is a minimum. Jones Stokers give a long, clean, smokeless flame with any coal, and are adapted for use with all kinds of industrial heating furnaces.

Write for a copy of the book: "Industrial Heating Furnaces"

THE UNDER-FEED STOKER CO. OF CANADA, Ltd.

81 Victoria St., - TORONTO

JONES STOKER

SOME MACHINERY SPECIALTIES AT THE TORONTO EXHIBITION

Rego Welding and Cutting Apparatus

Perhaps no exhibit in Machinery Hall at the Canadian National Exhibition attracted more attention from steel men and manufacturers generally than that of the Carter Welding Company of Toronto, Ltd., the feature of which was a demonstration of the working of their Rego Welding and Cutting Apparatus. The company claims that each and every part of the apparatus has been subjected to the severest engineering test before being put into production and that no experiments have been made at the user's expense. Basic principles claimed for the Rego Welding and Cutting Apparatus are economy of operation, safety, durability and perfectness of quality of flame-details. The Rego principle of gas mixture, whereby the acetylene enters the mixing chamber at a slightly higher pressure than the oxygen, positively insures the elimination of the flashback under any and all operating conditions. It materially reduces the oxygen pressure, thereby preventing any excess and wasteful oxygen detrimental to good welding, coming through the flame.

Dominion Steel Products Diesel Engine.

The Diesel type engine built and exhibited by the Dominion Steel Products Co. of Brantford, Ont., was the center of much interest at the Exhibition, as being the first Diesel-type engine completely designed and built in Canada.

The engine is a 75 k. w. 425 rpm. high-compression oil-motor.

The engine shown at the Exhibition is a one-man unit, is very compact and is completely self-contained. Equally steady under heavy and variable loads the engine embraces many features which have already demonstrated its remarkable success and utility. The electric generator is part of the complete outfit and the crane can pick up the complete self-contained unit and place it in position wherever required. It is claimed that this Dominion Steel Products engine will deliver more than 30% of the actual energy of the fuel as useful power at the pulley, in comparison with 14% from condensing steam plants, 10% from non-condensing steam plants, and 22% from low-compression gas or oil engines. Accessibility, which reduces the labor and cost of maintenance has been considered in every detail of design. The elements of the entire assembly have been so arranged that any group, and practically any single part, can be removed without disturbing adjacent parts.

Cole Steam Traps.

The exhibit of the Cole steam traps, which form a part of the Cole System of heat transmission and direct return, which is a specialty of the firm of George W. Cole, Ltd., of Toronto, included vacuum and lift traps, and specialised arrangements for heating boiler-feed water. This Company's experience in regard to conservation of heat in steam boiler and piping systems extends over twenty years, and they are equipped to advise regarding a department of power-raising which is often much neglected, particularly in small steam-power installations.

International Time Recorders..

The exhibit of the International Business Machine Co. Ltd., include a time-recording device, synchronized electrically, which sets itself, winds itself and is in every respect fully automatic. No batteries are used, and the device can be adapted to either alternating or direct current, and any number of clocks can be synchronized by one master clock. This Company manufactures over 260 different styles and sizes of time and cost recorders, and kindred devices associated with the mechanical recording of working hours, and the substitution of the impartiality and accuracy of the machine for the fallibitity of the clerk.

EDITORIAL

Fuel and World Politics

The British coal strike, and the tendency to equip ocean liners and engines of land transportation with oil-burning devices, is giving rise across the sea to a recrudescence of the much hackeyed question of the life of coal and oil reserves. One gentleman, without much statistical basis for his assertion, anounced his belief that by 1922 the shortage of petrol will be so pronounced in Europe as to force the abandonment of the use of private motor cars. The life of the coal seams is also being made the basis of gloomy forecasts. What is really the outlook for fuel supply?

The problem of fuel supply is more economic than physical. The recent great increase of the use of fuel oil is rather a reflex of the social status of the workers, and the chief advantage of oil-fuel is that it enables great economies in labor and attendance. At the present time, rock petroleum is the chief source of oil-fuel. A distinguishing feature of petroleum occurrences is that they are concealed, fluid, migratory, and, to a larger extent than in the case of any other raw material in large economic use, the quantity of petroleum available, its rate of production, and the reserve supply, are unascertainable.

Coal — bituminous coal — is a material of which we can measure the extent with comparative accuracy. It is also a material regarding which we have even yet only fragmentary knowledge, and probably more has been learned about the nature of coal in this century than in all the years preceding. Up to the present time the value of coal has been set by the cost of its production, rather than by its own value, but a remarkable readjustment of opinion is now taking place, more particularly in those old countries where coal is becoming relatively scarce, from an economic viewpoint, by reason that it has been mined for long periods.

This relative scarcity arises, as stated, from the economic side. Vast quantities of coal are as yet untouched in these older countries because the coal is found in thin seams, or is of inferior grade. Coal, like iron-ore, has a value purely relative to its availability, and the life of the world's coal reserves bids fair to be indefinitely prolonged as the increasing value of coal —arising from scarcity—permits the profitable utilisation of fuels that are now rejected as worthless. This is the situation in Europe, including Great Britain.

There are, however, countries possessing coal reserves of such immensity as to place their exhaustion—even their economic limitation of production—beyond imagination. Such countries are, in order of importance, the United States, Canada and China. In the case of the United States, that country's vast coal reserves are conveniently placed, occurring in areas long settled and opened up to modern transportation, possessing favorable climatic conditions, and possessed of such excellences of quality and physical accessibility as to have no known compeers.

Canadian coal reserves occur largely in areas as yet unsettled, unopened to transportation, and possessing in large part drawbacks in quality and physical accessibility. Nevertheless, next to the United States, Canadian deposits are the most potentially valuable in the world.

The deposits of China are very large, but they occur in districts as yet remote from transportation highways, and in a country not as yet enamoured of western industrialism, and we believe, fortunately not so.

To what conclusions do these considerations lead? Do they not indicate that their real serious effect upon world conditions will arise, not from any actual physical shortage of fuel, but from political tendencies which will see the gradual rise to power of those nations that can mine coal in largest quantity at the cheapest cost, and the gradual decline of those countries where coal costs are destined to become so prohibitive as to favor the importation of coal from other and more favored countries? This tendency will be mitigated, and may even be in large part offset, by the development of economies in consumption and necessitated invention in the older countries.

On this side of the Atlantic it would appear likely that the industrial predominance of the United States will become still more pronounced; and that in Canada we shall see an annually accelerating movement to the great western coalfield, and a readjustment of political power within the British Empire that will make Canada more and more an elder brother in the family of our associated British peoples.

The suggestion is put forward that in the great reserve of bituminous coal in the Canadian West lies the most immovable guarantee of Canada's political permanency, and future national importance, and we commend this consideration to political leaders in Canada.

CANADIAN ENGINEERING STANDARDS ASSOCIATION.

This Association has set out to accomplish a necessary duty in Canada, and one which is of especial interest to the iron and steel and metal working industries. The first standard specification issued by the Association, as is noted elsewhere in this issue, deals with steel railway-bridges, and other specifications are contemplated for rails and track, steel, steel forgings, screw threads, machine parts and electrical fittings. In many Canadian plants and mines standardization is not even strictly followed in the operations of associated companies, so that the field for improvement is quite extensive.

The co-operation of industrial executives with the Association is much to be desired, and, judging from the list of committee names has already been in large part achieved. The names of the officers and the members of the various committees are in themselves guarantees of the authoritative character of the specifications that the Association is working upon.

DEATH OF Mr. GEORGE TANGYE.

With the death of Mr. George Tangye, at the age of 85 years, there passes the last of four notable brothers, famous sons of Joseph Tangye, of Redruth, Cornwall. Mr. George Tangye dies at Heathfield Hall, Birmingham, formerly the home of James Watt, and in days gone by the meeting place of Josiah Wedgewood, Matthew Boulton, Erasmus Darwin and Joseph Priestley.

The grandfather, in the intervals of tilling his farm, obtained a situation as night-attendant of a mine pumping-engine, and used to say: "I drove the engine for ten hours, worked on the farm seven hours, and wasted the rest." Despite his old-fashioned ideas of labor, he lived to be 95 years of age. The association of the name of Tangye with the hydraulic jack, by the aid of which the "Great Eastern" was launched, and the Tangye steam-pump, is too well known to require repetition. The achievements of the Victorian age, when reviewed, were at least as remarkable as those of the present day, and, in very large part, we are but reaping the harvest of the labors of men who toiled hard and assiduously, and whose reward in length of days and the regard of men seems to have been so commensurate to their efforts as to raise a question whether, after all, the tendency of our day to lessen labor and lengthen ease is a desirable evolution.

LIGHTING AND HEATING CONSIDERATION IN MILL STRUCTURES.

At a recent gathering of illuminating engineers, it was pointed out that the modern style of mill and factory construction, which insists on large window areas, entails a permanently higher cost than architecture with a smaller provision of window area. Apart from the cost of glass replacement — which is an important consideration in steel and iron mills and shops —a large window area calls for a higher initial expenditure in construction, as the window area is higher in cost than ordinary wall area, and causes higher heating costs because of the greater heat radiation outwards through the window glass. It is contended by electrical engineers—who are of course interested parties in such a contention—that artificial light is cheaper, all costs considered, than daylight admitted through an excessive window area.

Much, of course, depends on the proportion of sunlight and the temperatures of a given locality, but, in Canada, where the amount of sunlight is above the average, and where winter temperatures range quite low, the possibility of overdoing the window idea seems not unlikely to happen. Of all the costs of comfortable human existence that of artificial heating seems least likely to cheapen, and increased attention is likely to be paid in the future to designing buildings so as to secure the maximum of heat economy.

OBITUARY.

Mr. F. H. Whitton, Hamilton, Ont.

Mr. F. H. Whitton, General Manager of the Steel Company of Canada died in hospital at Hamilton on October 24th, following an operation. He was born in Northamptonshire, England, and was 61 years at the time of his death. He was a Cambridge man, and after leaving college came to Canada and entered the service of the Grand Trunk Railway. Later he went to the United States, and returned to Canada as manager of the Ontario Tack Company, which position he held until 1907. When the Steel Company of Canada was formed, Mr. Whitton was appointed Assistant General Manager, and in 1916 became General Manager.

As an executive in the Canadian steel industry, Mr. Whitton was highly regarded by his associates. At the 1918 Annual Meeting of the Canadian Mining Institute, Mr. Whitton presented an historical and statistical paper on the steel and iron trades in Canada that has not been excelled, and the loss to the industry by Mr. Whitton's death is very great, for it is ill provided with men of Mr. Whitton's wide and interested knowledge of the peculiar and difficult problems that steel manufacture must overcome in Canada.

Mr. Whitton was a Roman Catholic, and is survived by his wife and one son, Mr. Corbett F. Whitton, who is the Assistant Secretary of the Steel Company of Canada.

The Steel Trade and the Tariff Enquiry.

A REVIEW

By the EDITOR.

At the time of writing the Cabinet Committee gathering information on which to base the tariff legislation that the Government proposes to formulate at the ensuing session of the Federal Houses, has finished its western tour and is taking evidence in the Maritime Provinces. With the taking of evidence in Montreal and Toronto the enquiry will be completed.

Up to the sitting at Sydney on November 6th the statements made by the representatives of steel and iron companies in Winnipeg, Medicine Hat and Vancouver have stressed the desirability of maintaining not less than the present protective tariff, and have been directed to confuting the arguments of the agriculturists. So far as can be gathered, the extent to which protective tariffs are favored on iron and steel products is in inverse ratio to the percentage of agriculturists included in the district in which evidence has been taken, and the opposition of the farmer to protective duties is mitigated in direct proportion to the extent to which steel and iron industries have penetrated into the agricultural districts.

With the possible exception of the Province of Saskatchewan, every province of Canada now contains established iron and steel industries. Sydney, New Glasgow, Truro and Amherst in Nova Scotia; Moncton and St. John in New Brunswick; Quebec, Three Rivers, Montreal, Sherbrooke and St. John in Quebec; Ottawa, Kingston, Hamilton, Welland, Collingwood, Port Arthur and a host of other towns in Ontario; Winnipeg, Calgary Medicine Hat, Edmonton and other places in the Prairie Provinces; Nelson, Vancouver and Victoria in British Columbia, are centres of population deriving livelihood to an ever increasing extent from branches of the iron and steel industry, ranging from the blast-furnace to an infinite variety of finished metal products.

There is not at this time any article made from iron, or its alloys, whether it relates to instruments of peace or war, that cannot be made in Canada, and the list of articles that are made in Canada are of gratifying variety and of acknowledged excellence.

At Winnipeg, the Massey-Harris Company presented what will probably be recognised as the most important and most determining document elicited by the enquiry. This statement dealt with three charges frequently made against the Massey-Harris Company, namely, that its products were sold abroad more cheaply than at home, that the cost of agricultural implements in Canada is greater than is warranted by the amount of protection and the freight differential when compared with United States prices, and that the rebates given to certain secondary iron and steel industries are unjustified bonuses to the implement manufacturer. Mr. Findley, the General Manager of the Massey-Harris Company proved that his company had never sold implements abroad cheaper than at home. He pointed out that comparisons made with United States prices were not truthful comparisons unless they took into account distances and local retailers' prices. A comparison of wholesale prices at manufacturing points was not a correct comparison. The rebates provided by the tariff were a part of the tariff itself, and were so arranged as to enable the Canadian manufacturer to be placed on a competitive basis with the United States manufacturer as the necessity arose.

Probably the best point made by Mr. Findley—and it is a point that is quite unrelated to the complexities of the tariff schedule itself—is that local competition is a much more important factor in establishing low prices than the absence of a customs duty on imports. The opponents of import duties have never established —nor have they attempted to establish—that removal of protection to the Canadian manufacturer would result in lower retail prices to the Canadian consumer. This is, of course, the implication in all anti-tariff argument, but its proof has always been lacking, and there is every reason to believe that the unrestricted control of the Canadian implement market which removal of the protective tariff would give to the United States manufacturer would eventually result in much higher prices for the Canadian farmer, without possibility of any redress or amelioration.

At Winnipeg, where the iron and steel industry has now assumed an importance greater than in any part of Canada west of Ontario, including as it does sheet-metal mills, rolling mills, foundries, structural steel plants, and factories for the manufacture of automobiles, farm tractors and implements, it was pointed out that at the time when tractors were placed on the free list no less than nine companies were in a position to make tractors in the Dominion, all of which firms have without exception lost money, and have either abandoned the tractor industry, or will do so. From February 1918 to May 1920, 25,200 tractors have been imported into Canada duty free, representing a value of $23,000,000, and it was estimated by the Alberta Foundry and Machine Co. that 10,000 tractors, all of which would be imported, would be sold in the western provinces in the coming year.

In Vancouver it was stated that the steel industry required not only tariff protection, but definite state aid, and the Commission was informed of the general desire that prevails in British Columbia for a blast-furnace plant that will permit the manufacture of pig-iron, from British Columbia iron-ores and coal, and the subsequent manufacture of steel in the Province. The policy of previous governments in giving financial aid to the steel industry in the East was reviewed, and British Columbia's request for similar consideration was preferred.

Mr. Nicol Thompson stated that there were 200 metal-working companies in the Province, in addition to the steel shipbuilding plants on the Coast, all of which would greatly benefit by the establishment of a local source of steel and iron supply.

At Nelson, Mr. W. M. Cunliffe, of the Nelson Iron Works, made a statement showing the necessity for protection of local foundries against those at Spokane.

At Port Arthur, the chief argument for protection was the idle steel plant, and the desirability of state aid to re-establish the iron-ore mining industry in the Port Arthur section was set forth in a memorandum presented by Mr. J. J. O'Connor.

At Sydney, Nova Scotia, the evidence given illus-

trated the inescapable union of the tariff question as it relates to the coal and steel industries.

Colonel Thomas Cantley asked for a higher specific duty on coal, pointing out that the duty on coal which represented from 20 to 25 per cent of its cost at United States mines before the war now represents less than one-third of the pre-war rate, and is entirely inadequate and inoperative as a protective tariff. He believed that a specific duty of one dollar per ton on imported coal would in ten years result in Canada becoming independent in coal supply, and would enormously increase the wealth of the Dominion.

The handicaps of the Nova Scotia iron and steel producer were detailed by Colonel Cantley, a digest of whose statement is elsewhere included in this issue. The difficult position of the basic producer of iron and steel in the Maritime Provinces in relation to the Quebec and Ontario market was emphasised, and the total abolition of the free list in steel items and a large increase in the coal duty was urged.

The time at the disposal of the Cabinet Committee is now so short, that it is hardly to be expected the length of the hearings will be commensurate to the relative importance of the steel and iron industries, or their great variety, in Quebec and Ontario. The representations of the several companies will doubtless be almost entirely in written form, and some definite assistance will in all probability be given to the industry by labor representatives, more particularly as the shadow of unemployment is now darkening, and the victory of high tariff interests in the recent United States elections has to be reckoned with.

Two things will probably be prominently before the Cabinet Commission when it has completed its enquiry, so far as the steel and iron trades are concerned, namely, the languishing and unprogressive character of the basic part of the industry, to wit, in production of raw materials and in capacity for production of pig-iron and steel refining; and the tremendous extension in Canada of those branches of the steel, iron and metal-working industries that rely on the United States for their primary products. In other words, manufacture and fabrication totally overshadows home production from the radical elements of Canadian soil, and this fact is likely to prove the main preoccupation of the Cabinet when it tries to reconcile the conflicting elements without damaging the general prosperity of the coal and iron trades and their derivatives in Canada.

The inverted nature of our industrial pyramid in Canada is disclosed by the fact that in 1919 the total value of mineral products produced from the soil of the Dominion was 173 million dollars. The value of coal, petroleum and iron and steel imported into Canada in 1919 totalled 273 million dollars. On mineral production alone, therefore, not counting other things, our international account must be posted with 100 million dollars on the debit side of the ledger.

This may even be a necessary condition, a postulate that would allow scope for interminable argument, but it cannot be argued that it is a good condition, **for Canada**.

A dispassionate review of the economic development of Canada, written before the war by Prof. O. D. Skelton of Queen's University, concluded with the statement that Canada would probably always require some protection for its industries through import tariffs so long as that policy was maintained in the United States "from whence it came." Those who can discern any tendency to lowering of tariffs in the United States, or see any lessening of the competitive power of that country, can be but slightly acquainted with the extent of the power, industrial, financial and numerical that resides to the south, or with the slight extent to which this power has yet been exerted outside its national boundaries.

GREY AND MALLEABLE CAST IRON.

British Research Association Formed.

A meeting was held in Birmingham (England) on the 30th September last in connection with the proposal to form a British Research Association for the Grey and Malleable Cast Iron Industries. The Lord Mayor of Birmingham (Alderman W. A. Cadbury) welcomed the representatives of the industries concerned, who had gathered from various parts of Great Britain, and on the conclusion of the Lord Mayor's speech the chair was taken by Mr. M. Riddell, president of the Institution of British Foundrymen. Sir Frank Heath, K.C.B., of the Government Department for Scientific and Industrial Research gave an address in which he outlined the terms upon which the Government would assist the scheme. The main features of the plan are that firms in the industry who join the Association should each guarantee a minimum annual subscription for a period of five years: then, with a definite minimum income guaranteed, the Government would assist the Association with grants of money to the extent of pound for pound, but at the end of the five year period would gradually diminish their contribution as the scheme became self supporting. The Government would require certain conditions to be fulfilled, and urged, without making it an absolute condition, that Labor should be represented on the Council of the Association. Sir Frank described each firm's subscription to the scheme as an insurance premium against the evil effects of ignorance.

Dr. Leslie Aitchison (Birmingham) moved, and Mr. F. J. Cook (Birmingham) seconded a resolution to the effect "That a Research Association for Grey and Malleable Cast Iron be formed." Mr. W. R. Barclay (Birmingham) and Mr. B. Collitt (Lincoln) spoke in support of the resolution, which was passed nem. con. A vote of thanks to Sir Frank Heath for his address was passed with applause, and a Provisional Council was elected to proceed with the formation of the Association.

DEATH OF A LEADER IN BRITISH STEEL CIRCLES

The death is announced of Mr. Henry Steel, Chairman of the United Steel Companies, Limited. This great overseas steel combination, with an aggregate capital of £9,000,000, includes the Frodingham Iron & Steel Co., the Workington Iron & Steel Co., the Rothervale Collieries, the Appleby Iron Co., Daniel Doncaster & Sons, Ltd., the Martino Steel & Metal Co., and an interest in the stamping work of Thos. Smith & Co., this list of companies being added to an existing amalgamation of Steel, Peach & Tozer and Samuel Fox & Co., of Stocksbridge formed in 1916.

Mr. Steel was an outstanding figure in British steel circles, and his death is attributed to overwork. He had Canadian connections, being a member of the London Advisory Board of the Dominion Steel Corporation, and visited Canada, with other British steel-masters, during the Summer.

Winnipeg Meeting of the Canadian Institute of Mining and Metallurgy

25th. to 28th. October 1920

Although the proceedings of the Winnipeg Meeting of the Canadian Institute of Mining and Metallurgy were largely taken up with papers and discussions upon the precious metal deposits of Northern Manitoba and the utilisation of western coal, much of the interest of the gathering turned upon the visit of inspection made by the attendants at the meeting to the two thriving metallurgical plants at Selkirk, namely, the mills of the Manitoba Bridge & Iron Co., and the plant of the Manitoba Steel Foundries.

To most of those in attendance at the meeting, the most significant feature of this western metallurgical development was the manner in which the fuel problem was being solved, in one instance by the use of powdered western coal, and in another instance by use of the electric furnace.

Mr. H. A. Mackay, the Chief Engineer of the Manitoba Bridge & Iron Co., read a paper before the Institute describing the various steps by which the use of western coal, in powdered form, had been perfected and applied with most gratifying results to the reheating furnace, and to an open-hearth furnace. The reading of Mr. Mackay's paper proved to be one of those rare occasions which occur at technical meetings when it falls to the lot of one who has played a leading part in the development of a new utilization of raw material to explain the process from the beginning to a successful consummation. Deposits of raw material are never valuable until processes for their profitable use are evolved, and the achievement of the Manitoba Bridge & Iron Company's officials in proving that western coal is adapted to metallurgical uses places a new value on the western coalfield.

The initial and most difficult problem to be overcome in the use of western coal in powdered form arises from the low ash fusibility of many of these coals, which raises special difficulties where, as in the case of the open-hearth furnace, it is necessary to pass the products of combustion through narrow flues and checkers. The difficulty is not so pronounced in connection with the re-heating furnace. A feature in favor of western coals is the practical absence of sulphur content.

The distinctive feature of the pulverising plant at Selkirk is the long rotary dryer, the unusual length of which was explained by Mr. Mackay as due to the fact that part was in stock, but to this length is attributed much of the success of the installation. It has been found possible to dry and successfully pulverise coal that was saturated with moisture, in addition to its natural moisture content.

In the discussion which followed the reading of Mr. Mackay's paper, Mr. M. A. Daley, Fuel Supervisor of the Northern Pacific Railway, said that the difficulties connected with the use of powdered coal, containing a high ash content of low fusibility, had been successfully overcome in a Milwaukee plant by the interposition of water-cooled tubes in the path of heated gases thereby causing the deposition of the suspended ash. Previously to this innovation, much trouble had been experienced with the deposition of honeycombs of ash, and a tendency to vitrification of the deposited ash, blocking up the exit flues.

The Selkirk Plant, Manitoba Bridge & Iron Co.

This plant, which was visited by the Institute members in the afternoon of October 28th, consists of well-constructed brick buildings, on a site permitting of much future extension. The capital investment represented in the plant and buildings is about one million dollars. Some three to four hundred workmen are employed.

The Rolling Mills include heating furnaces, rolling, cogging and strip and bar mills. Scrap iron, locally gathered, is used, and large quantities were seen in stock in the yard. There is apparently a large wastage of iron and steel parts in the West.

The open-hearth plant is equipped with a fifteen-ton McLain-Carter furnace, and, as stated, has been successfully operated by powdered coal, but at the time of the visit of the Institute, was under repairs. The coal is powdered to 100-mesh. The capacity of the open-hearth plant is from 60 to 90 tons of steel ingots daily, and the demand locally is anticipated to take this quantity easily. There is a shortage of reinforcing steel and steel bars in the West.

Up to the time when western coal was substituted in the Rolling Mills, which was early in 1920, some 15,000 tons of United States coal had been imported annually. The use of powdered coal now enables the Canadian product to be used exclusively. Mr. Deacon, the President, stated that only two coals in the West had been found entirely suitable. The coal in use comes from Saunder's Creek, Alberta.

Manitoba Steel Foundries.

This Company operates a steel foundry, the melt being made by two Snyder electric furnaces, operated by current supplied by the Winnipeg Electric Railway Co., from the Lac du Bonnet power-site. The Company has its own independent motor-generator set for supplying the furnace current, thus avoiding any surge on the power company's system.

Western Iron Ore Sources.

A carefully compiled and thoughtful paper was read by Captain H. E. Knobel of Port Arthur on "The Use of Ontario Ores for Canadian Furnaces". The text of this paper (by permission of the Institute) is given in this issue.

In the discussion upon the paper, Dr. Allan of the University of Alberta referred to the apparent absence of any important or commercially utilisable supplies of iron ore in the great central plain, but mentioned a deposit of magnetite with high titanium content in the Crow's Nest Pass district, and the likelihood of iron-ore deposits in the Mackenzie River Basin. Newly observed deposits of hematite and limonite was also reported from the Peace River country.

Mr. F. W. Gray, said that Captain Knobel was to be thanked for his fair and lucid statement of the iron-ore possibilities of the Port Arthur district, but believed the real problem was not one of the availability of suitable ore, but rather of fuel costs.

Speaking as Secretary of the Iron & Steel Section of the Institute, Mr. Gray said this had not been active, and suggested that possibly the policy of sectionalizing the activities of the Institute was mistakenly conceived at this stage of national growth. He thought

that the best way for any particular technical interest to make itself felt was to contribute to the Institute's papers and discussions. The Institute had a wide field to cover, and its activities were sufficiently sectionalized by geographical exigencies to make it doubtful whether further dissection of its activities were desirable. The suggestion to form a coal-mining section of the Institute had not been pressed by those who had first proposed it, largely because when the proposal was analyzed in an attempt to put it into practice it had been realized that it would tend to division.

Alloy Steels.

Mr. F. A. Fahrenwald was listed to speak on "Non-Corrosive Steels" with particular reference to reseaches into a possible non-corrosive metal for gun-barrels. Mr. Fahrenwald changed his subject, stating that his prepared paper would be presented through the Bulletin, and gave an illuminating talk on the general question of alloy steels. He showed a table of elements arranged in groups, and explained their family inter-relationships, which guide the metallurgist in his search for alloys designed to fit special purposes.

In connection with the corrosion of gun-barrels, this had been discovered to be occasioned by the alkaline residue of the primers used in detonation. Certain alloys were found to give resistance to corrosion, but also possessed undesirable physical qualities. After exhaustive experiments, iron-nickel and iron-chromium alloys were proved to give the best combination.

The speaker referred to an alloy which he had perfected for use in automobile pistons. The co-efficient of expansion differed from that of the cylinder case in such a manner that clearances between the piston and the cylinder could be reduced to a minimum, with the assurance that when the metals were heated the piston would not bind.

Alloys for resistance to high temperatures were also discussed, in particular the iron-chromium combination is being developed to fill a demand for moving parts required to operate under high temperatures and possess high physical strength. Such a metal would solve some of the problems met with in the utilisation of oil-shales. Aluminum, magnesium, cobalt and titanium were also mentioned as alloy metals. Titanium alloys were assuming considerable importance, and in this connection the mention of a titanium iron in the Crow's Nest District by Dr. Allan was interesting. Chromium, said Mr. Fahrenwald, was becoming a "king-pin" among alloy metals.

In answer to a question, the speaker said that cobalt could be sold for alloy purposes in larger quantities if produced at a lower cost. It was a desirable alloy for many purposes, but its cost was high.

Mr. Fahrenwald commented the provinces of Alberta and Saskatchewan in having scientific men so well represented in public affairs, and said that in new districts today the true pioneer was the scientist, and the greatest progress would be realized where this fact was recognised.

Of interest to the steel industry is the recent discovery of nickel in Northern Manitoba, associated with norite of Sudbury type. Molybdenum and cobalt are also reported from the same district.

Considering that Winnipeg has not hitherto been looked upon as a centre of metallurgical interest in Canada, the amount of interest taken in the iron and steel industry, and the very important progress made there is encouraging and the intimate connection between mining and metallurgy is well illustrated by the great interest taken by the coal-mining members of the Institute in the Selkirk iron and steel plants.

About one hundred persons attended the meetings, which occupied three days ending the 28th October.

Freyn, Brassert & Company, Chicago, have been retained as Engineers by the Algoma Steel Corporation, Ltd., Sault Ste. Marie, Ontario, Canada for the rebuilding of their No. 3 Blast Furnace.

No. 4 Furnace of this Company was recently entirely rebuilt by the same engineers, the furnace lines being considerably changed from the original installation; new hearth and bosh installed; the furnace height being increased by the addition of new dome top to existing shell, also inclusive of gas seal, receiving hopper and throat; new offtakes and downcomer being provided; skip incline being straightened, raised and lengthened, and new coke bin being provided.

WINNIPEG MEETING, CANADIAN INSTITUTE OF MINING AND METALLURGY.
OCTOBER 25th to 28th, 1920.

Group of Attendants at the Meeting, Fort Garry Hotel.

Iron Ores of Commerce with Special Reference to Canadian Deposits

By SAMUEL GROVES, Ottawa.

(Continued from Page 270, October issue)

MAGNETITE.

Canadian Deposits (continued).

South Eastern Ontario.

In southeastern Ontario, quite a number of magnetite deposits have been unearthed and developed in the counties of Haliburton, Peterborough, Hastings, Renfrew, Frontenac, Lanark, and Leeds. But none of the ore-bodies are of large extent; and up to date, the combined production has been some 725,000 tons. The ores vary in character from "lean magnetite gneiss with bands and ribs of magnetite, to deposits of nearly pure magnetite." The iron content averages from 50 to 55%; but cobbing was necessary before the ore could be used in the blast furnace. In 1906, one of the ore-bodies in Peterborough county was lauded in the technical press as "one of the richest deposits of magnetite in existence: estimated at the very least at 4,000,000 tons"; and was declared to be superior to the Dannemora magnetite, which has been the source of the Sheffield cutlery industry. These fulsome claims were based on a private report by the Provincial Geologist. (1) In this report, magnetite ore gathered on the surface, and magnetically separated and concentrated, was said to contain:—

	Per cent.
Metallic iron	71.01
Sulphur	0.11
Phosphorus	0.016

This analysis of a single, hand-picked, surface specimen, was doubtless correct; but, as a criterion for determining the economic value of the general ore-body, was not in accordance with the Baconion method of induction; with the inevitable result that, subsequent development of this property has not substantiated the wonderful claims made. Actual mining showed that the ore was very irregular in character; while the following analysis of the crude ore demonstrated that it was far from possessing the qualities of the celebrated Swedish Dannemora magnetite:

Iron	51.20
Silica	12.10
Sulphur	0.34
Phosphorus	0.032
Lime	4.87
Magnesia	3.93
Titanium	0.10

A magnetometric survey (2), roughly estimated a probable area of 4300 square feet in which ore was likely to occur; but the proviso was made, that "a large percentage of this area is undoubtedly occupied by barren rock". Upon resuming mining operations in 1911, some 126 tons of ore was shipped to the Port Colborne blast furnace; 28 tons in 1912; and 5.592 tons in 1913; but although the Provincial inspector reported on a visit to the mine in 1913, that the ore-body appeared "to be widening in depth, and the grade rising," not a ton of ore has been shipped since that date.

These negative results have dissipated the nebulous dream of having found in southeastern Ontario, a source of magnetite from which to build up a modern Sheffield in Canada.

At the present time all the magnetite ore mines in southern Ontario are shut down; and viewing the problem from an economic standpoint, farsighted operators are convinced that the only solution for the future is **co-operation.** It is certain that no individual has sufficient ore of commercial grade to keep a modern smelting plant going continuously, and economically. The estimated tonnage of the combined magnetite mines in this region does not exceed a few million tons.

Quebec.

Continuing eastward, we cross the Ottawa river into the province of Quebec, and again find magnetite deposits of importance: some of which have been known since 1830. Two mines: one, the Forsyth, is located about 6 miles north of Ottawa city, in the Hull range of the Laurentian mountains; and the other the Bristol, situated some 4.8 miles north of Chats Falls, have been developed commercially: the former since 1854, and the latter since 1872. In 1880, after several years of smelting in a blast furnace at Ironsides, nearby, the entire Hull range group of mines: Forsyth, Baldwin, and Lawless, were shut down; and fourteen years later (1894) the Bristol mine ceased operations also — due largely, to obsolete working conditions. All the available evidence goes to show that these Ottawa Valley magnetites are fairly high-grade, and in commercial quantity; and, if economically concentrated and electrically smelted, are sufficient to supply the common needs of the iron trade in the vicinage of the Capital of the Dominion for many years to come.

Small deposits of titaniferous magnetites have been reported as existing in Beauce, Saguenai, St. Maurice, and Terrebonne counties in the south of the Province, bordering on St. Lawrence; and some of these finds in the Lake St. John district have an iron content of over 50%, but are impregnated with 10 to 15% of titanium: an impurity that would have rendered such ores — a few years ago — practically useless for iron-making purposes. Since 1906, however,, the electrothermic process of smelting has made it possible to utilize, economically, even these inferior ores. And since it is estimated that in the St. John mine, alone, there are some 5,000,000 tons of titaniferous magnetites available, it is possible that within a very few years, necessity may lead to profitable mining thereof.

Northern Quebec.

Perhaps the most interesting outlook is in the far north of the Province, south of Ungava bay. Ever since Dr. A. P. Low, in 1895, made a geological survey of the Cambrian area in northern Quebec, and published the results in an official document containing startling revelations of iron ore resources, as great, if not greater, than those discovered in 1845, in the

(1) B. F. Haanel and E. Lindeman, 1911.
(2) January 6, 1906.

Lake Superior region of the United States — the exploitation of which has placed that country in the fore-front of industrial nations — the imagination of enterprising Canadian prospectors has been fired with visions of financial glory, as vivid as Raleigh, Drake, and the old buccaneers had of the prospects of the Spanish Main. That their anticipations are within the range of possibility, the following brief account will show.

Dr. Low's survey cross-cut the iron-bearing region of northern Quebec, in two places, situated at least 125 miles apart. Descending the Koksoak river, which discharges into Ungava bay, he perceived an almost continuous exposure of iron ore for 9 miles, along this river: which is situated near the northern boundary of the so-called "iron district." Then, returning to Ungava bay, he travelled by steamer up to and through the Straits, down the Atlantic coast, entering the iron-bearing region again, by way of the Hamilton river: cutting into the southern boundary of the iron district, where he observed, and in his report mentions, iron ore outcrops which evidenced inexhaustible quantities.

Influenced by the pioneer work and attractive geological story of Dr. Low, a syndicate of interested prospectors decided to get confirmatory technical data on the alleged iron ore deposits of magnitude, and information regarding the physical configuration of the Quebec northland ; and, at the same time, to study, on the spot, as to whether conditions were favourable to the economic development and commercial marketing of the iron ore. They, therefore, engaged an expert mining engineer, having thorough technical training and wide practical experience, to make an exhaustive study and investigation. He commenced his explorations in 1912: starting from Sudbury in northern Ontario, from whence he walked clear through to Labrador — following the Cambrian formation. This exploit took five years to accomplish.

In 1917, however, inferring from the fact that for some 420 miles along the north shore of the St. Lawrence — beginning about 240 miles from the Atlantic ocean, and practically terminating 155 miles east of Quebec city — there abound rich deposits of magnetic iron sand, concentrated chiefly at the deltas of the

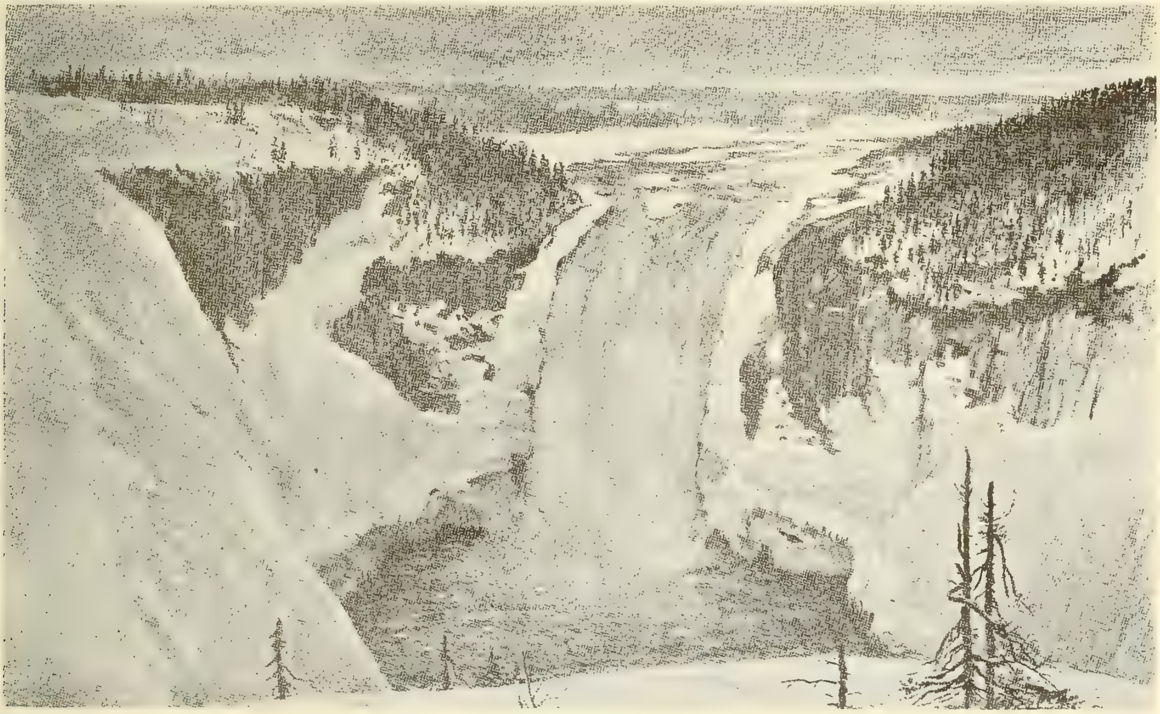
Showing location of allocated iron ore deposit in Northern Quebec between latitudes 54-58 deg., and longitudes 67-69 deg., south of Ungava Bay, in the vicinity of Grand Falls, Hamilton River

various tributary rivers, and that these ferruginous shore deposits must have had their origin in the erosion of extensive iron ore beds in northern Quebec, it was decided to explore from the St. Lawrence, northwards, following the course of the rivers. Accordingly, in March 1917, the engineer, starting from the St. Lawrence, at Seven Islands, wended his way by trail and portage along the Moisie river and the water courses northward, up through 15 miles of hilly country in which the waters have cut deeply into the granite, forming banks 300 to 400 feet above the river bed. But after travelling some 80 miles, these narrow defiles open out into wide valleys, in which progress is easier, to the height-of-land, up to which a 4-10th grade railway is feasible. At the end of about 220 miles travel **the southern extremity of the Cambrian belt of iron ore is reached**: in the vicinity of Ashuanipi lake, where the iron ridges, running north to south, cover a width of 25 miles, approximately.

means of electric energy; for the immense ore fields are within economic working distance of the celebrated Grand Falls and rapids of the Hamilton river.

A private, technical survey has been made of the water power possibilities in the vicinity of Grand Falls; and it has been ascertained that by damming the waters of the upper Hamilton river, just above Grand Falls, they can be diverted through a chain of small lakes known as "Big Hill Portage," and that by this 4½ miles diversion, the head of water can be increased from 420 to say 960 feet: giving a possible development of say 2,500,000 horse-power — thus providing one of the greatest water powers on the American continent.

This provision of nature is a God-send; for the use of steam power is practically impossible, owing to the absence of coal within a measurable distance of the iron-bearing district. By the utilization of cheap electric energy, however, to operate drills, giant shovels, and transportation system — for it is contemplated



GRAND FALLS:
On Hamilton River, Northern Quebec.

In 1918, the iron ore located north of Petitsihapan lake, outcropped in such prodigality, that the expeditionary force estimated that with the limits defined on the map, as areas A. B. C, and D, respectively, the available iron ore — of good quality — would probably amount to 6,000,000,000 tons.

A reference to the accompanying map will show that the "Northern Quebec Iron District" is embraced within latitude 54—58 deg., and longitude 67—69 deg.; the respective distances to the known boundaries of the deposits being 50 miles south of Ungava bay; 300 miles from the St. Lawrence; and 200 miles from the Atlantic ocean. Prospected and surveyed areas of considerable magnitude, have already been allocated by the Quebec government, for immediate exploitation and development.

One unique feature of this particular enterprize is, that the greater part of the mining operations and transportation of the product can be performed by laying down an electrically operated railway from great wharves at Seven Islands on the St. Lawrence, up to the height-of-land, and right into the heart of the iron region — economic production would be guaranteed from the beginning. This juxtaposition of comparatively high-grade iron ore and of electricity, would give the operators a great advantage in the world's competition; for it is conservatively computed, that 8,000 tons of iron ore can be placed, daily, on the St. Lawrence — only 200 miles from the Atlantic ocean — at a cost of $2.40 per ton; as contrasted with Missabe ore at from $4.50 to $5.00 per ton, f.o.b. lower lake ports.

It is true that severe climatic and entomological conditions are ahead of all enterprises in New Quebec; but just as the Arctic terrors of the Yukon have been braved, and the malarial horrors of Panama have been conquered by modern science, so, the physical difficulties peculiar to the Ungava region

will be overcome; a new hive of industry on a colossal scale will be established, and the wilderness be made to blossom as the rose.

After the iron-bearing district has been opened up to civilization, there is nothing to hinder the introduction of electric smelting of the ores into pig-iron, or even steel ingots ; since there is available electric energy and limestone on the spot, in unlimited quantity, while suitable coke can be procured economically. It should not be forgotten that Canada has been the world pioneer in electric smelting, and was the first to demonstrate that even highly refractory iron ores, incapable of reduction in the ordinary blast furnace, can be economically smelted in furnaces operated by the electro-thermic process: provided cheap electric energy is obtainable. These conditions are ideal in the promising industrial region under consideration.

While the foregoing statement of the case for the coming development of New Quebec may seem highly colored, the affirmations made are based upon facts.

Startling rumors are constantly appearing in the newspapers, emanating from eager prospectors in the northlands—particularly from the southern shores of James Bay, and Ungava bay—of rich iron ore deposits uncovered in those regions. At the present moment (July 1920.) private parties are travelling unexplored parts of the northern Quebec wilderness —even using aeroplanes—in search of El Dorados, and we need not be surprised at any announcement; for the country in the vicinity of the height-of-land is undoubtedly rich in precious metals and stones; while in the large areas of sedimentary rocks that abound, magnetite, hematite, and siderite iron ores, outcrop in abundance.

So universal is the demand for iron ore, and so great the potential resources of New Quebec, that it is safe to predict, that when the proposed Ungava railway materializes; the projected Hudson Bay line of steamers is established; and the electric railway, from Grand Falls, down to the St. Lawrence is in operation, industrial activity in the districts bordering on Ungava bay, and in the vicinity of Grand Falls, will be important factors in the coming commercial prosperity of the Dominion.

Another source of iron ore supply in the Province of Quebec is the magnetic iron sand on the north shore of the lower St. Lawrence: beginning at Portneuf, 155 miles east of Quebec city, continuing, erratically, at the deltas of the various tributary rivers for some 420 miles, and terminating at the mouth of the Olomanoshibo — about 240 miles from the Atlantic ocean.

The existence of these ferruginous shore deposits is no new discovery, for their commercial value was recognized 50 years ago. In 1867, metallurgical tests were made; resulting in the installation, at Moisie, of a magnetic separation and concentration plant, and eight bloomery furnaces: which produced one gross ton of iron per day, per furnace; with a fuel expenditure of 6,990 pounds of charcoal per ton of iron. Part of the blooms were shipped to Montreal, where they were rolled into railway axles; for the iron was reputed to be of excellent quality—equal to the best Swedish—and capable of being converted into the finest steels. A ready sale for the product was found in the United States, in spite of a "pig-iron" duty of $7 per ton. In 1875, however, trade invidiousness had the blooms classified as "bar iron", and imposed thereon a tariff of 1½ cents per pound. This protective imposition made it impossible to sell in the American market at a profit, while the Canadian trade was too limited and precarious; the result being, that the works were shut down, the company went into liquidation, and the plant has been idle ever since.

In 1904—almost simultaneous with the investigation of the black sands of the Pacific coast, by Dr. Day of the United States Geological Survey—there was a revival of interest in the magnetic iron sands on the north shore of the St. Lawrence gulf, and formal examination under the auspices of European capital, was made. A few years later, a systematic investigation of the magnetic iron sands at the mouth of the Natashkwan—530 miles east of Quebec city—was instituted by the Mines Branch of the Department of Mines, Ottawa.* A summary conclusion deducted from these experiments is, that in the treeless dune at the mouth of the Natashkwan, alone, there are "at least 500,000 tons of magnetic ore concentrate that will average 67 per cent iron." Taking into consideration the actual manufacturing experience at Moisie as to the high quality of the iron produced from these magnetic iron sands; the perfection to which the electrothermic process of smelting and steel making has attained; the proximity to abundant charcoal fuel;; cheap water transportation; and increasing demand for iron and steel products in the Province of Quebec itself, the possibilities of a revival of the iron industry in the Gulf of St. Lawrence, is manifest. Someday, the iron and steel industry of the Province of Quebec will not be con-

Lac a la Tortue.—Bog Iron Ore (showing Dredge formerly employed).

*The Magnetic Iron Sands of Natashkwan, County of Saguenay, Province of Quebec. By Geo. C. Mackenzie, B.Sc., pp. 49, 1912. Mines Branch, Ottawa.

centrated in the vicinity of Montreal; but will spread —as already predicted—to Pontiac county, near Ottawa; to the Ungava region in the far north; and to the lower St. Lawrence.

Maritime Provinces.

In the Maritime Provinces, surface indications of iron ore occurrences are widespread; but this fact instead of being a favorable sign of the existence of large and profitable ore-bodies, may be taken as *prima facie* evidence of the very contrary. Outside the "Laurentian Shield", iron-bearing waters have played a very important part in the deposition of shallow iron ore bodies; and in no part of the Dominion is this more conspicuous than in the Provinces bordering on the Atlantic. Wherever comparatively deep deposits are found, it is largely due to agencies which have caused the localization of iron-bearing solutions: such as impermeable rock basins, or other persistent geological structures or strata which arrest distribution, induce concentration and deposition in particular localities, and thus form massive beds of iron ore: as in the Lake Superior district of the U. S. A., and, in a smaller way, at Torbrook, Nova Scotia. Throughout the Maritime Provinces the greater part of the known iron ore occurrences are of Devonian age, and consist, mostly, of comparatively shallow deposits of specular hematite and brown limonite. What magnetite there is, may be said to be due to the metamorphism of existing hematite ores. A characteristic feature of the magnetites that have been worked is, that they are practically free from sulphur and titanium; but high in phosphorus: all containing more than the steel-making limit of 0.05 phosphorus.

New Brunswick.

The largest known magnetite deposit in New Brunswick is at the Bathurst mine, near Austin Brook, Gloucester county. Based upon a magnetometric survey, and diamond drilling, it is estimated that there are some 18,600,000 tons of ore available—having an iron content of 43 to 47 per cent. Concentration of these ores, by crushing, screening, and jigging, began in 1911, and over 180,000 tons of ore were shipped or trans-shipped over the especially constructed 16-mile track to the Intercolonial Railway, at Black Cats, or the new ore docks at Newcastle; but the average improvement in the iron content, due to concentration, was only 2 per cent, hence, the operations were found to be unprofitable, and in 1913 the plant was shut down.

About nine miles north of the Bathurst mine, another magnetite ore-body has been discovered—on what is known as the Ellis claim. This deposit has been traced for over 900 feet, and shows a width of 4 to 14 feet, with an iron content of 45 to 48 per cent. Nothing, however, has been done with it; the experience at Bathurst mine, being doubtless, a deterent.

With the exception of the Austin Brook group (where a siliceous magnetite is intermixed with hematite, and therefore can not be utilized straight, owing to the difference in fusion levels; and can not be concentrated economically, since the hematite is non-magnetic) and the "Ellis" deposit, no magnetite occurrences of commercial size and quality have, so far, been discovered in New Brunswick.

Nova Scotia.

Although iron ore occurrences in Nova Scotia are found almost everywhere, yet, very little of the local ore has been utilized in the immense iron and steel industries at Sydney and New Glasgow. In 1916, some 914,000 tons of iron ore was used in the Nova Scotia blast furnaces, all of which was imported from the British colony of Newfoundland. Between the years 1876—1913, inclusive, 1,666,924 tons of iron ore was mined in the Province; but since the latter date, mining operations have practically ceased. The reason for this cessation is, that the ore deposits hitherto developed have become either too meagre in quantity, or too low-grade in quality, to compete with the more cheaply mined and higher grade ores of the extensive Wabana iron ore field of Newfoundland.

As far back as 1825, a furnace and foundry were erected in Annapolis county, and high hopes were entertained that the siliceous magnetite deposits in the Nictaux-Torbrook area south of the Annapolis river would prove to be a profitable source of iron ore for the establishment of a self supporting iron industry in the Province. But although mines were opened on the south and north ranges of the Nictaux and Black rivers, and at other places in this iron-bearing district; and although improved concentrationary methods were tried, and facilities for convenient transportation provided, the last of the series of Nictaux-Torbrook magnetite mines shut down in 1913.

After a close scrutiny of the reliable technical literature on the iron ore resources of Nova Scotia, it is safe to say, that while it is the unexpected that is always happening, neither geological survey, diamond drilling, nor dip needle investigations warrant the probable discovery of any large deposits of magnetite in that seaboard province. At the same time, there are numerous indications of the existence of smaller magnetite bodies of commercial value, which, in the coming days of electrothermic smelting and manufacture, may be profitably utilized in the production of malleable iron supplies and finished steel articles, in which quality and not quantity is the objectve.

The great drawback, hitherto, to the exploitation of Canadian magnetites generally, has been their almost universal high sulphur content; together with other objectionable impurities, such as titanium. This difficulty, however, has been practically overcome by the use of the electric furnace. By means of the electro-thermic process of smelting iron ores, the very best pig-iron, as has been proven,* can be made from ores which contain as high as 1.5 per cent. of sulphur; whereas an ordinary blast furnace will not handle an ore which contains more than 0.1 per cent. of sulphur. A like success with the electric furnace has been achieved when using refractory titaniferous, and nickeliferous-pyrrhotite ores.

Before passing to a consideration of hematite ores, it may be appropriate to refer to the Swedish method of surveying for magnetic iron ores, introduced into Canada, in 1903, by Dr. Eugene Haanel. This system takes advantage of the fact that magnetite ore bodies may be considered as huge magnets, outcrop-

---

*See Report No. 16, on the Experiments made at Sault Ste. Marie, under the auspices of the Dominion Government, in the smelting of Canadian ores by the Electro-thermic Process. By Eugene Haanel, 1907.

ping or underlying the earth's surface.* If, therefore, an area of ground known to contain iron ore, and which gives indications of magnetic disturbance of the earth's normal field, is traversed with an instrument of precision, such as the Thalen-Tiburg magnetomer, measurement of the changes indicated may be made, the location and extent of the ore-body ascertained; and in many cases, the strike, direction of dip, and depth of the deposit below the surface, may be determined.

*See treatise "On the location of magnetic ore deposits by magnetometric measurements," by Dr. Eugene Haanel, 1904.

(To be Continued).

ELECTRIC SMELTING OF IRON ORE IN NORWAY

Government Assistance.

The fact that Norway, while rich in iron ore, imports between 300,000 and 400,000 tons of iron and steel annually has often been the subject of comment. Native expert opinion has frequently asserted that, given suitable power supply, the country could produce iron and steel in quantities sufficient to meet its own requirements. Mr. Ragnvald Blakstad, who owns ironworks in the Tyssedal, Norway, has recently asserted that it would be possible to produce from 4,000,000 to 5,000,000 tons of iron ore concentrates annually, and, by the use of hydro-electric power, work up the ore into iron and steel products ample in amount to meet the native demand. Mr. Blakstad has himself installed electric furnaces for the smelting of concentrates, but states that he is unable to obtain permission to carry on the work. If the water powers of the country were developed in an adequate manner, foreign supplies of fuel would become superfluous.

According to a U. S. Consular Report, some years ago two brothers by name of Stiig, employed at the Trollhatten power plant at Sweden, claimed to have invented a process for the electrical smelting of iron ore whereby only about 350 kg. of coke would be required for the manufacture of one metric ton of pig-iron. The Sima Company, of Christiania, became interested in the proposition and contracted with the inventors to continue their experiments for the further development of their process. Within the past year the company has succeeded in interesting the Norwegian Government in making a subvention of 500,000 kr. (say £27,750) to assist in the erection of furnaces for the practical application of the Stiig process. The terms of the subvention require that 700,000 kr. (under £40,000) be raised independently of the Government. The process mentioned has been carefully examined by a committee of experts appointed by the Norsk Investment Company, which is handling the financial side of the enterprise; the Committee reported very favourably. The Sima Company proposed to build immediately a large plant, including a rolling mill, but the Committee declined to recommend so ambitious a project before the process had been thoroughly tested. The Government has also provided for a subvention enterprise at Narvik, this being known as the Narvik Staal og Valseverk (Narvik Steelworks and Rolling Mills). It is understood that the process of smelting iron proposed by this company is identical with the Stiig process. The Government has granted a subvention of 16,000,000 kr. (about £90,000) to the Narvik project.

COMPANY NOTES

Nova Scotia Steel & Coal Co.

October production at the Sydney Mines Plant was as follows:

	Tons.
Coke	9,026
Pig-iron	6,596
Steel	11,634
Coal	50,800

A new colliery, to be known as No. 7 Mine, is being opened near Bonar Head, and the railway is under construction. The coal is reported to be of good quality.

Production for the nine months ending October 31st. has been as follows:

	Coal	Coke	Pig-iron	Steel
January	52,256	6,032	6,059	9,562
February	48,880	8,535	6,595	10,285
March	56,182	10,173	7,408	10,554
April	51,377	9,689	7,258	9,520
May	50,327	10,197	7,445	9,981
June	56,307	8,213	7,112	11,700
July	51,472	7,739	7,608	10,454
August	47,843	7,868	7,504	12,285
September	51,468	8,008	6,643	11,013
October	50,800	9,026	6,957	11,364

Iron ore output at Wabana, Newfoundland is averaging 25,000 tons per month. Export shipments were resumed in September, and several cargoes have been sold to outside consumers.

The New Glasgow mills continue to work to capacity.

Dominion Iron & Steel Co.

Production of coal was slightly larger in October than for several months, totalling 272,000 tons. Steel production was 27,000 tons. The rail mill has been idle for several weeks, but there is a possibility that it may be re-started shortly. Three blast furnaces are in operation, a fourth having been ready for putting into blast for two months, but delayed because of unsettled conditions at the coal mines. The progress of operations at the Sydney Plant during the ensuing Winter depends very largely upon the result of the negotiations connected with the wages of the coal-miners, not concluded at the time of writing.

New Brunswick Rolling Mills Purchase Obsolete Naval Craft.

The "Niobe" and two obsolete submarines, which formed part of the Canadian Navy, have been purchased for breaking-up purposes by the New Brunswick Rolling Mills, St. John, N.B. The "Niobe" was used as an aviation trainin-school during the war, and was in Halifax Harbor at the time of the explosion. No person below decks on the "Niobe" was inured on this occasion.

Universal Plate Mill for Hamilton.

Dominion Foundries & Steel, Ltd., of Hamilton proposes the addition of a 27 by 40 by 72 inch universal

plate mill to its plant, at an estimated cost of $1,500,000, capable of rolling sheared plate up to 66 inches in width. Operation of the new mill is expected to start in December, and a sufficient Canadian demand is anticipated to enable the mill to work at capacity, if adequate tariff protection is maintained.

Lake Superior Corporation Increases Steel Production.

Lake Superior Corporation affairs are in a satisfactory state according to the quarterly report on operations to the shareholders. For the three months ending September 30 the output of coke, pig-iron and steel ingots showed a considerable increase over the corresponding period of last year. The shipments of iron and steel are also much higher, being 142,246 tons compared with 48,229 tons. Unfilled orders on September 30, including pig-iron and steel, for delivery in the last quarter of 1920, were 200,000 tons, and a satisfactory demand is offering for delivery in the first quarter of 1921. The output of Lake Superior coal and of limestone shows an increase, while that of Cannelton coal is lower.

Favorable reports on the operations of the Algoma Central & Hudson Bay Railway and of the Algoma Central are also submitted. The recent increase in freight rates granted by the Dominion Railway Commission, although accompanied by an increase in wages has improved the situation and it is expected that the earnings for the year will show a gratifying improvement. Operating results on the Algoma Eastern for the three month period have been satisfactory and traffic conditions are expected to further improve.

The following figures of comparative output of the chief metallic products handled by the Corporation are given for the three month period ending September 30th, in the two years :

	1920	1919	
Magpie ore	32,210	67,420	tons
Coke	142,593	65,998	"
Pig-Iron	116,362	50,149	"
Steel ingots	92,671	55,456	"

Canada Iron Foundries and Civic Improvements.

Canada Iron Foundries, Limited St. Thomas, Ont., is cooperating with the St. Thomas Horticultural Society in the proposed boulevarding at the east entrance to the city along the property of the company and that of the Michigan Central Railway Company. A boulevarde 35 feet wide is to be constructed along the south side of Talbot Street with flowers and ornamental shrubs for a back ground.

Midland Iron and Steel Co. Ltd.

The Midland Iron and Steel Company, Limited, had a successful blow-in of their furnace at Midland on October 20th and the second run of iron was right on grade. The company is making foundry iron and is turning out about 125 tons per day.

Mechanical Loaders & Paper Machinery to be Made at Port Arthur, Ont.

The Port Arthur Shipbuilding Company announces that negotiations are proceeding for the manufacture of mining machinery at their plant.

Mr. Samuel Hoare, representing the Canadian Mining Shovel Company, of Virginia, Minn., and closed contracts for the construction of a considerable number of Armstrong shovel loaders, in addition to the contract already in hand. The first of those completed was thoroughly tested out during the past week, and came up to requirements. Others are being assembled, and the first shipment of them will go forward the early part of next week.

In addition to mining machinery, the company will add the manufacture of a full line of papermaking machinery including all classes of grinders, wet-machines, chippers, digesters and heavy paper making machines.

The acreage, and floor space of the shops are ample to accomodate an enterprise of this kind, in addition to the shipbuilding operations of the company.

Vice-President P. G. Chase, states that the company is assured of steady work for another year, and that with negotiations for further shipbuilding contracts that have reached a favorable stage, he expects to be able to announce the signing of new contracts in the near future.

The Reliance Mill and Trading Company, of New York, will handle the sales of the paper-making machinery for the company.

Iron-ore at Lake Nepigon, Ont.

A magnetic survey is being carried out on a large tract of iron ore lands, lying east of Poplar Ledge, Lake Nepigon. These lands were recently diamond drilled by United States interests, with very gratifying results.

Wire Rope Manufacture at Vancouver, B.C.

The Britannia Wire Rope Company, who are a branch of the English Company of the same name, have recently completed their buildings on Granville Island, Vancouver, B.C., and are now installing the necessary machinery for "laying" various types of wire ropes for the Canadian market. While the wire for making the rope is being imported from England for the present, the company intend eventually to bring in their own steel and draw the necessary wire at the Granville Island plant. Similarly, skilled workers are being brought over from Great Britain at first, but local men will be trained in "laying" wire ropes as soon as possible. About fifty hands will be employed when operations are commenced.

Canadian Locomotive Co., Kingston, Ont.

With an order recently received for four locomotives for the Temiskaming & Ontario Railway, the Canadian Locomotive Company is stated to have orders for 28 locomotives, which will keep the plant employed until February 1921.

Slag Fertilizer Manufacture at Sydney, N.S.

Sir William Cross, head of the Cross Fertilizer Plant in Sydney, who recently visited the works, states that they are working to capacity, and expect to produce 42,000 tons of slag fertilizer in Sydney during 1920. The plant started with an output of 6,000 tons in 1913, and sales have annually increased. Sir William Cross said that his company proposed extending the grinding capacity of the plant should the mooted merger of steel companies lead to an increased production of suitable slag.

Armstrong Whitworth of Canada to Make Hydraulic Machinery.

Armstrong Whitworth & Co., announce that the manufacture of water-wheels of the Francis and Pelton

type will be undertaken at the Montreal Plant. The firm of Jensen & Dahl of Christiana, Norway who will be associated with Messrs. Armstrong Whitworth in this work, are well-known in Europe as makers of water-turbines and also of pulp-wood machinery.

Cockshutt Plow Company's Annual Report.

The Annual Report of the Cockshutt Plow Co., shows net profits of $660,221 in 1920 compared with $571,586 in 1921. The profits of the Company were not as large as they might have been owing to the insufficiency of the plant to meet the demand upon its capacity, and to cope with the growing business, additions to the plant at Brantford are now well advanced.

St. Lawrence Welding Co., Montreal.

This Company is preparing to place on the market shortly a new collapsible automobile tire-rim, which will enable tire to be removed with a minimum of effort in fifteen seconds. The rim is to be made of hardened even-tempered steel.

Canadian Drawn Steel Co., Hamilton.

Speaking of the future of the steel industry, Mr. S. J. Waddie, President of the Canadian Drawn Steel Company, Hamilton, Ont., expressed the opinion that the immediate future was not likely to be affected to anything like the same degree as other lines of industry might be. As for the company he is associated with Mr. Waddie said that there were sufficient orders on hand to insure uninterrupted operations for a long time to come. Retrenchment was something his company had had no occasion to consider so far. All employees are at work and the plant is operating at full capacity. The greater part of the production is for the domestic market. "We could get much more work to do if we could only get the raw material," said Mr. Waddie, "but we experience the greatest difficulty in this connection, with the result that our export market has been crippled somewhat."

LARGE BRIDGE PROJECTED IN VIRGINIA, U.S.

For the purpose of connecting Norfolk with Portsmouth, Virginia, across the intervening Elizabeth River, several designs are projected for a bridge. The cantilever design contains a span of 1,850 feet between tower centres, or 50 ft. longer than the present longest cantilever at Quebec, and 140 ft. longer than the spans of the Forth Bridge. The improvements include a tunnel, and the estimated cost is $20,000,000.

The plans have been developed by the Tyrell Engineering Co., of Norfolk, Va.

"Freyn, Brassert & Company, Engineers, Chicago, have been appointed Consulting Engineers for the Royal Netherlands Blast Furnace and Steel Works Company, The Hague, and plans and purchases are under way for the construction of two blast furnaces at Ijmuiden, Holland. The plant is planned along American lines throughout, inclusive of furnaces, hot blast stoves, gas washing, ferro concrete bins, charging, blowing and other equipment.

Trade Items

MONTREAL.

The Magnolia Metal Co., has started work on an addition to cost $25,000 exclusive of equipment. When completed the extension will enable the company to triple its output.

The Simonds Canada Saw Co., Ltd., manufacturer of saws, knives, files, steel, etc., is building a one-story, 70 x 175 ft. addition, to cost about $50,000. It is expected that the building will be completed and the machinery installed within a month.

The Automotive Engineering Co., Ltd., has been incorporated to enter into business as engineers, iron and brass founders, steam, electric and other engine manufacturers, machinists, boiler makers, etc., with $500,000 capital stock.

The Dunwin Motors, Ltd., have been incorporated to manufacture engines, motors, machinery, etc., with $100,000 capital stock.

The Pyke Motor & Yacht Co., Ltd., has been incorporated to manufacture motors, engines, machinery, boats, aeroplanes.

Hodgson, Freck, Ltd., has been incorporated to engage in the business of tool-makers, brass founders, boilermakers, steel converters, etc. with $100,000 capital.

QUEBEC.

The Quebec Marine Works, Ltd., has been incorporated to manufacture engines, motors, machinery, heating appliances, etc., with $25,000 capital stock.

Adolphe Huot Ltd., has been incorporated to manufacture stoves, furnaces, heating appliances radiators, etc., with $200,000 capital stock.

TORONTO.

The Dyrob Steel (Consolidated), Ltd., has been incorporated with a capital stock of $1,000,000 by James R. Roaf, William C. Cope, and others to manufacture machinery, castings, forgings, etc.

The Precision Tool Works, Ltd., has been incorporated with a capital stock of $40,000 by Reginald Homer, Henry S. Moore and others to manufacture metal tools and dies, stampings, etc.

The Motor Sundries Corporation, Ltd., has been incorporated with a capital stock of $500,000 by Russell P. Locke, Grant Cooper and others, to manufacture automobiles, motorcycles, parts engines, etc.

Kinsinger-Bruce, Ltd., Niagara Falls, Ont., has been incorporated with a capital stock of $250,000 by William McGuire, George F. Rooney and others, all of Toronto, to manufacture machinery, tools, car fittings, etc.

HAMILTON, ONT.

The Dominion Lock Joint Pipe Co. Ltd., has been incorporated with a capital stock of $50,000, by C. V Langs, E. G. Binkley, and others.

The Carr Pattern & Tool Co., Ltd., has been incorporated to manufacture tools and special machinery, implements, patterns, etc., with $40,000 capital, by John Carr, Robert Christie. and others.

LONDON, ONT.

The Ruggles Motor Truck Co., Ltd., has been incorporated with a capital stock of $3,000,000 by George McE. Reid, John F. Grant, John C. Elliott and others to manufacture motor trucks, tractors, farm implements, etc.

Steel Sashes, Ltd., have been incorporated to manufacture metal sashes, building material, hardware,

etc., with $40,000 capital, by Wiliam R. Jarmain, Urban A. Buchner, and others.

Work will start at once on three buildings at London, Ont., for the Service Motor Truck Co., Wabash, Ind., which will be the first units of a plant to ultimately cost $5,000,000.

The Bogart-Carlough Corporation, Paterson, N. J., manufacturer of steel sash and allied products, will establish a plant at London, Ont., and has secured temporary quarters at Bathurst and Adelaide streets.

BRANTFORD, ONT.

The Brantford Machine & Tool Co., Ltd., has been incorporated with a capital stock of $50,000 by Robert O. Cumback, William J. Ham and others to manufacture machinery, tools, motors, etc. It is building an addition to its plant to cast $50,000.

Abrasives, Ltd., has been incorporated with a capital stock of $600,000 by William T. Henderson, Albert H. Boddy, Christopher Cook and others to manufacture abrasives, tools, machinery, etc.

BELLEVILLE, ONT.

The National Castings, Ltd., have been incorporated to manufacture iron, steel and other metals, castings, forgings, machinery, tools, etc., with $50,000 capital, by Norman L. Turner, Frederick Daniels and others.

WINDSOR, ONT.

Burroughs Machines, Ltd., has been incorporated with a capital stock of $1,000,000 by Sydney E. Wedd, Roy B. Whitchead, and others, all of Toronto. It is building a factory at a cost of $250,000 for the manufacture of adding and other machines.

WALKERVILLE, ONT.

A four-story addition is being made to the plant of the Fisher Body Co. of Canada Ltd, and will be completed about the first of the year. The new building will give an additional 75,000 ft. of floor space and will cost $275,000.

FORT WILLIAM, ONT.

The Four Drive Tractor Co., Big Rapids, Mich., is contemplating the erection of a large assembling plant here.

POSITION OF THE STEEL COMPANIES IN NOVA SCOTIA.

Digest of Evidence Given Before the Cabinet Committee at Sydney, 6th November.

Colonel Thomas Cantley presented the case for the Nova Scotia steel companies before the Minister of Finance and the Minister of Labor at a one day hearing on tariff matters at Sydney, on October 6th.

A digest of Colonel Cantley's statement is as follows:

Iron Ore All Imported From Newfoundland.

Nova Scotia blast furnaces and associated steel plants are wholly dependent upon Wabana, Newfoundland, ore, a considerable portion of which is won from submarine areas at a point one and a half to two miles from the surface hoisting plants. This ore, freighted by sea to North Sydney and Sydney, is subject to an export tax levied by the Newfoundland Government. The ore averages about 50 per cent metallic iron and is used wholly in the blast furnaces of the Scotia and Dominion companies without the admixture of other ores, the pig iron being conveyed in a fluid state to basic open-hearth furnaces for conversion into steel ingots.

Scotia Ore Not Now Used.

While the knowledge that Nova Scotia contained iron ores dates back over three centuries, or, to be correct, to the year 1604, and ore is known to occur in fifteen of the eighteen counties of the province, the quanitity mined was never large. During the period of thirty-six years from 1876 to 1911, when iron ore production practically ceased, the total iron ore mined within the province was 1,667,936 tons, equivalent to, say, 834,000 tons in pig iron. The iron and steel plants situated in Cape Breton are dependent wholly on Wabana ores.

Raw Materials Entirely of British Origin.

While both the Nova Scotia and Ontario steel plants obtain practically all the ores they smelt outside of Canada, there is this difference, that used by the Ontario furnaces is American in origin, while the Nova Scotia furnaces use Newfoundland, i.e., British, ore. The burden of the blast furnaces of the eastern steel plants is made up of Newfoundland ore, local limestone, flux and coke made from Nova Scotia coal. The Ontario steel plants, on the other hand, use both American ore and American fuel, both practically duty free (bituminous coal used in coke ovens producing coke for smelting purposes is subject to a drawback of 99 per cent, of the duty).

The labor involved in the production of the fuel used in the eastern steel plants in the production of pig iron and steel ingots from Newfoundland iron ore is equivalent to over fifty per cent. of the total cost of production. This labor has now no protection whatever, inasmuch as the coal used for similar purposes by the Ontario furnaces is practically duty free.

Distance from Central Canadian Markets a Handicap.

As to market—save for an almost negligible portion —all the production of Nova Scotia plants must find a market at or west of Montreal, to reach which they must absorb a rail freight of $7.50 per net ton in full carload lots to Montreal and $11.30 to Toronto. The situation of the Ontario plants enables them to market a very considerable portion of their output immediately at or comparatively close to their plants, while for all markets west of Hamilton and the Soo, they are free of all cost of transport from Nova Scotia to the Soo, equal to an advantage of roughly $11 per net ton.

Bounty-Fostered Industry Proved of Great War-time Value.

The establishment of modern iron and steel plants in Ontario and Nova Scotia and their development to a point where they became important factors in the manufacturing life of the Dominion was due very largely to the bounties paid by the federal treasury from 1896 to 1910. But for the development of the iron and steel industry thus fostered, Canada, in 1914, would not have been in a position to have supplied from her native furnaces, mills and forges, the steel required for the manufacture of munitions, and a very large section of the manufacturing plants and skilled labor of Canada would have been idle during the whole war period, and all but a very small proportion of the $1,200,000,000 representing the export value of munitions shipped from Canada to Europe would have been lost with the enormous advantage which flowed back to Canada from that export.

Increased Protection Asked for Coal and Steel.

When it is remembered that lower wages and a much lower scale of living prevail in large sections of Europe and to somewhat less extent in Great Britain, that transportation costs from European iron and steel pro-

ducing centres, to Montreal and Toronto, are actually less than the railway freight now charged from Sydney and New Glasgow to the same points, it is clearly evident that such conditions can only be equalized by a substantial amount of protection.

Canadian iron and steel producers confront in the United States a condition of affairs, although somewhat different, equally onerous. The plants in that country have been long established, have a home market numerically twelve and a half times as great as ours, while most of their plants are situated at points comparatively near the centre of Canadian consumption and are enabled to freight their production to Canadian consuming points at very much less than similar products produced in the Maritime Provinces of Canada. On the other hand, Canadian furnaces are in turn met by much higher protection, indeed, save on pig iron, prohibitive duties, if they attempt to export to that country.

For these reasons and others equally important, which are gone into in more detail in the memorandum dealing with the whole situation, and which is respectfully submitted for the further consideration of the commission, we appeal for a revised tariff which will provide by way of increased duties and the total abolition of the free list steel items, a substantial amount of Nova Scotia, which has contributed so largely to the development and wealth of Canada with but a very small return to shareholders.

MAKING PROVIDENCE AN OFFENSE

A further example of the pronounced attitude of diverse governmental authorities these days to sit in high judgment on business methods and to dictate principles disturbing to normal enterprise is presented by a report of the federal trade commission to the senate just made public on the "Causes of High Prices of Farm Implements." The trade commission in its report attributes the marked increase in the cost of agricultural implements to the farmers something like 62 per cent from 1916 to 1918, and the high profits derived by the manufacturers accordingly, to the result of concerted action among the latter. In connection with its investigations into the increased cost of farm implements, the trade commission has incorporated into its report the results of an inquiry into the manner in which the antitrust decree against the International Harvester Co. has been executed. The commission explains in this connection that it is empowered by law to investigate the matter in which a final decree in any antitrust suit is being carried out.

As a remedy for this continuing position of domination the commission proposes that the International Harvester Co. shall be divested of its steel plant, the Wisconsin Steel Co., and two of its most important manufacturing works.

On this point the commission report says:

"The dominating position of the International Harvester Co. is chiefly with respect to the harvesting-machine lines and particularly with respect to grain binders. The maintenance of this position is aided by the steelmaking business of the company which furnishes it either with large profits or with steel at cost, thereby further increasing the International Harvester Co.'s dominating position by reducing its already low costs of manufacture."

Business men well may inquire in the light of this reasoning of the trade commission when does commercial providence cease to be a virtue and become an offense in the eyes of the law. Are manufacturers to be denied the right to protect themselves on their own raw material supplies? Shall business receive no benefits from the exercise of foresight and sound judgment? The International Harvester Co. is a manufacturer of a finished product of common use and steel represents one of its most important raw materials. To deny it the privilege of protecting itself on steel would be exactly similar to prohibiting a publisher from entering into the manufacture of paper or an automobile manufacturer from engaging in the production of some material essential to his purposes. Carried further it could be invoked to prevent an iron or steel company from controlling its own iron ore supplies.

The suspicion cannot be escaped that the federal trade commission in advancing this line of reasoning was talking purely for farmer consumption and was not advocating something for which it could expect seriously a common sense acceptance.—"Iron Trade Review."

TORONTO MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The 40th Anniversary of the founding of the American Society of Mechanical Engineers was celebrated by the Ontario Section of the society at a meeting in the School of Science building on Nov. 5th. Telegrams were read from the parent society in New York and from a number of local sections in the United States, and other Engineering bodies expressing the cordial feeling between engineers and congratulations on the 40th birthday. There was also received a cablegram from the Institution of Mechanical Engineers of London, England, reading:—

"Heartiest Greetings on occasion fortieth anniversary events recent years which demonstrated importance of engineers to civilization and established their power in industrial world indicate necessity for continued expansion of engineering societies activities. signed Institution of Mechanical Engineers of London".

Prof. James Trail gave an illustrated talk on the Power Canal of the Chippewa development of the Hydro Electric Power Commission. This was specially arranged as advance information for the members, who have been invited by the Commission's Engineers to visit the canal. This trip to Niagara will take place within a few weeks and further announcement will be made.

After the lecture, an attempt was made to get in touch by wireless telephone with the Boston section of the A. S. M. N. who were expected to be sending out messages in connection with their part in the anniversary celebration. The local receiving apparatus under the care of Messrs. Rosebrugh, Duncan and Hill of the Faculty of Applied Science of the University was working perfectly and picked up messages from a number of sources but none from Boston. The audience listened through multiple telephone receivers to a concert received over the wireless telephone and were much interested in a description of war time wireless by Mr. Duncan. As the expected Boston message later came in by ordinary wire it would appear that the local electrical engineers had done their full duty.

SHIPBUILDING

STEEL SHIPBUILDING IN CANADA.

Recent events in connection with steel shipbuilding in Canada are discouraging. As was remarked in our October issue, all but foolish optimists expected that when the demand for freighting vessels, caused by submarine destruction, had been satisfied, there would be in Canada a process of elimination of those shipyards that did not possess the elements of permanence, such as strategic location, nearness to sources of material and an artisan population, and affiliations with allied industries possessed of reserve financial resources.

Last month's issue of this paper listed as having been closed down the Dominion Shipbuilding Company's yard at Toronto, the British American plant at Welland, the Foundation Company's yard at Vancouver and the coming closing of the Harbor Marine Company's yard at Victoria. There has since been announced the bankruptcy of the Prince Rupert Drydock & Engineering Co., with two vessels in an unfinished state that were being built to the order of the Government. As in the case of the "Canadian Squatter" the vessels will be completed by the Government.

The process of commercial attrition should not be allowed to proceed too far, if, as we believe, the Government has a policy looking towards the perpetuation of a Canadian mercantile marine and the continuance of steel-shipbuilding in Canada, otherwise the industry will run the danger of entire disappearance while waiting for a declaration of policy. Without definite state aid, in one form or another, it is unlikely that steel-shipbuilding at this time can survive in Canada. The time is coming, of course, when steel-shipbuilding and every industry that is based on coal will flourish mightily in Canada, but that time is not yet. It would be a pity to see an established industry die by slow stages, as seems not unlikely, unless a vigorous policy of state aid is declared and put into effect.

There are several locations in Canada, notably Halifax, Montreal and Vancouver, where a steel shipbuilding industry is as necessary as port improvements or Customs houses, and possibly the shipyards at these places at this stage of Canada's growth, could exist commercially by repair work and the building of small coastwise craft, but they will not in the near future take the place they could take in the shipyards of the world unless Canada will follow the lead of other countries that have fostered shipbuilding and adopt a policy of direct financial aid for such a period as may seem necessary to tide over the period of testing that the industry seems now to have entered upon.

"Swansong" of the British-American Shipbuilding Co.

At the trial trip of the "Canadian Squatter", built at Welland, and fitted together at Vickers's Yard, Montreal, a luncheon was given on board by Mr. Archibald Welch, President of the British-America Shipbuilding Company of Welland to a representative company of shipping men and officials of the Canadian Shipbuilders' & Engineers' Association. Mr. Welch gave an address which was called by the Montreal "Gazette" the swan-song of the Welland Plant, and stated that if certain action had been jointly taken by Canadian shipbuilders it would have been possible to obtain orders from France that would have kept shipbuilding companies busy.

Prince Rupert Shipyard in Liquidation.

The Prince Rupert Drydock & Engineering Co. has gone into liquidation. Two vessels, of 8,400 tons dw., are in an unfinished condition on the stocks, and the closing down of the work would throw 800 men out of employment. Under the terms of the contract the Government owns the vessels, and is protected by a guarantee bond, but in any case the vessels will be carried to completion.

Launch of the "Canadian Commander".

Mrs. Ballantyne, the wife of the Minister of Marine, launched the "Canadian Commander" at the Canadian-Vickers Yard, Montreal on the 30th October.

There were present at the launching, in addition to Mrs. & Mrs. Ballantyne, Sir Fred. Orr-Lewis the President of Canadian-Vickers, and a distinguished company of visitors.

The launching was made the occasion of an important statement by the President of the Canadian-Vickers, who set forth the necessity for foreign orders to keep the Canadian yards going, and the difficulty that arose from the depreciated exchange of European customers. Mr. Ballantyne said the Government realised the significance of the problem, and had set aside twenty million dollars to assist Canadian yards in obtaining foreign orders, but, said the Minister of Marine, "the Government recognises that this is not the permanent solution of the problem."

Sir Fred. Orr-Lewis said, in part:

In 1918, the Canadian-Vickers, Limited, had a payroll of four and one-half million dollars annually with 3,500 workers. Today the company has a payroll of from three to three and a half millions and only 2,200 men, which, as Sir Frederick remarked, "is quite a difference in the dinner pail as well as in other quarters." This was due to lack of shipbuilding materials and slow delivery. It was further pointed out by Sir Frederick that the very bread and butter of this great national industry was, the building of cargo steamers, not alone for the Canadian Government, but more especially for foreign interests and for the world at large. This was essential if the shipbuilding industry in Canada was to hold its own with other shipbuilding nations.

Two freighters had been already been built this year for Norwegian interests and two more were building. "But we cannot expect," Sir Frederick explained, "that countries like Norway or Britain will continue to spend their depreciated currency in Canada. We must have a Government subsidy, to absorb the exchange at least. Unless this is done, the prospects are not too rosy."

Pointing out that the industry has no lack of men and is now to be provided with steel plates made in Canada, Sir Frederick tendered the thanks of the company to Mr. Ballantyne.

The C. G. M. Marine.

The Hon. C. C. Ballantyne thanked Sir Frederick on behalf of his wife, adding that this was the first vessel she had christened. He turned his remarks directly to the shipbuilding industry in Canada and the activities of the Canadian Government Merchant Marine, of which the vessel just launched was only one. Sixty-three ships, he stated, would be in operation under the C.G.M.M. flag by next season. These ships ranged from 3,750 tons to 10,000 tons.

Ten ships of 8,450 tons, he added, had been built for the C.G.M.M. by this yard and two of 4,500 tons. The value of these contracts had been over seventeen million dollars and at a lower average cost per ton than any other of the 17 shipbuilding yards of Canada.

The Minister then alluded to the even larger shipbuilding yard at Halifax with four berths, stating that today the shipbuilding industry of Canada represented invested capital of 47 million dollars and employed 50,000 men.

Dominion Shipyard, Toronto, to Resume Building.

It is stated in Toronto that the Dominion Shipbuilding Company, which has been idle for the past several months, will start up again at the end of November. When the shipyards closed down the company had in hand two unfinished Government boats. In order to complete these and finish the contracts the Government has requested the Henry Hope Company of Peterboro to do the work.. This they have consented to do and will probably commence work about the end of November. It is hoped that further orders may come in and that the works may be kept running throughout the winter.

New Passenger Vessel for Canada Steamships Co.

A large steamer for service on the Toronto-Niagara line, to carry 4,000 passengers and to have a moving picture theatre aboard, will be built by the Canada Steamship Lines, Ltd., and is to be ready for next season, according to an announcement made by J. W. Norcross, president of the Canada Steamship Lines.

CANADIAN ENGINEERING STANDARDS ASSOCIATION.

Issues Standard Specification for Steel Railway Bridge.

The first standard specification issued by the Canadian Engineering Standards Association deals with steel railway bridges, and is the work of a sectional committee on Steel Bridge and Construction, of which Mr. G. H. Duggan, Dominion Bridge Company, is Chairman, and a sub-committee on Steel Railway Bridges, of which Mr. P. B. Motley, Canadian Pacific Railway, Montreal, is Chairman. The personnel of the two committees speaks more convincingly for the authoritative character of its work than anything else could, and most certainly guarantees the standard character of the specification.

The objects of the Canadian Engineering Standards Association, as set out in its official circular, are as follows:—

Constitution.

The Canadian Engineering Standards Association was formed in 1919 with the object of carrying out in Canada, for the benefit of Canadian industry, work similar to that done in England by the British Engineering Standards Association, which has proved of such great industrial value. The Canadian Engineering Standards Association is not a Government institution, although it is recognized by the Canadian Government. The members, who serve on its committees gratuitously, are qualified by their technical and industrial standing to represent the interests of manufacturers, engineers and users, and are nominated by such bodies as the Canadian Manufacturers Association, the Canadian Mining Institute, the Engineering Institute of Canada, the engineering schools of the universities, the railway services, important industrial firms and the great purchasing departments of the Canadian Government.

The Association has been incorporated by Dominion Charter.

Finance.

The Association is supported by contributions from the technical and industrial societies interested, as well as from individual firms, and these are supplemented by a grant from the Dominion Government.

Method of Work.

When a request or suggestion is received from some responsible firm or person to the effect that the formulation or revision of a Canadian Standard is desirable, the Association confers with the various interests likely to be affected by the establishments of such a standard, and arranges for the organization of a committee to consider the matter. This committee includes representatives of the producers and users of the standard in question, together with such technical advisers as may be considered desirable. The selection of such a working committee is accomplished through the proper sectional committee of the Association, under the chairmanship of a member of the Association. If the committee so formed recommends the adoption or modification of a standard, its findings are reviewed by the Association, the Main Committee of which must be thoroughly satisfied that full consideration has been given to the subject before it authorizes publication by the Association.

The actual discussions as regards technical details are thus carried out by specially chosen representatives of the manufacturers and purchases, and the various interests, whether of the producer, the user, or the engineer, are safe-guarded, since all these parties have a voice in the decisions reached. In this way is is clear that before a report, defining a "Canadian Standard," is issued or modified, the effective approval of all concerned will have been obtained.

The services of the various sectional and sub-committees are of course available for the "periodical revision" of their reports, this being necessary in order to avoid any risk of retaining a standard in use after improvements or changes of practice have rendered it obsolete in any respect.

There is reason to believe that the success of the work done by the British Engineering Standards Association in the past has been largely due to the careful way in which its main committee has reviewed the work of its various sectional and other committees.

The C. E. S. A. standard specifications will, as a rule, contain simply the technical clauses necessary for the purchase of the product to which the specification relates, together with such tables and diagrams as may be required for their explanation.

Testing Not Undertaken.

Attention should be drawn to the fact that while the work of the Association would naturally be in close touch with that of the Standards Laboratory or Bureau of Standards now projected as a part of the proposed Research Institute, the functions of the two organizations are distinct. The Association having been requested to formulate a standard specification or set of dimensions and having done so, does not propose to undertake the duty of a testing authority in determining whether or not a given product complies with its conditions. Such duties should be (and it is hoped will be) performed in Canada by an official Standards Laboratory as part of its regular work.

Meaning of Standardization.

In order to avoid misunderstanding it may be pointed out that the term "Standardization" refers primarily to the preparation of such designs, dimensions or specifications in industrial, manufacturing, or construction work as will be generally accepted and worked to by all concerned. In the case, for insance, of a machine component, if its principal dimensions and characteristics are standardized, the number of types or patterns to be made or kept in stock commercially is at once reduced, lessening accordingly the cost of manufacture and handling, with corresponding saving and convenience to users.

Work in Progress

Eight sectional committees, four sub-committees, and two special committees have now been formed (February 28, 1920), as per following list. None of these committees has yet had time to complete its first report, although it is expected that several will be ready for publication at an early date.

Sectional Committee on Aircraft Parts.—Prof. P. Gillespie, University of Toronto, Chairman.

Sectional Committee on Steel Bridges and Construction—G. H. Duggan, Dominion Bridge Co., Chairman.

Sub-Committee on Steel Railway Bridges—P. B. Motley, Engineer of Bridges, C.P.R., Chairman.

Electrical Sectional Committee—Dr. L. A. Herdt, McGill University, Chairman.

Sub-Committee on Incandescent Lamps—John Murphy, Dept. of Railways and Canals, Chairman.

Sub-Committee on Transformers.—A. A. Dion, Ottawa Electric Company, Chairman.

Sub-Committee on Telegraph and Telephone Wire—W. J. Duckworth, G.N.W. Telegraph Company, Toronto, Chairman.

Sectional Committee on Wire Rope—Prof. H. M. Mackay, McGill University, Chairman.

Sectional Committee on Rails and Track.—J. M. R. Fairbairn, Chief Engineer C.P.R., Chairman.

Sectional Committee on Screw Threads.—H. H. Vaughan, Dominion Bridge Co., Chairman.

Sectional Committe on Steel.—J. G. Morrow, Steel Co. of Canada, Hamilton, Chairman.

Sectional Committee on Machine Parts.—A. R. Goldie, Goldie & McCulloch, Galt, Chairman.

Special Committee to confer with British Delegates regarding Electrical Fittings.—E. G. Burr, Consulting Engineer, Montreal, Chairman.

Special Committee on Material for Steel Forgings.—J. Leitch, Collingwood Shipbuilding Company, Chairman.

In most of these cases the Committee having collected the necessary information as to the present practice in Canada, is considering the available data with a view of formulating a draft specification.

Subjects Under Consideration and Awaiting Action.

A large number of subjects on which action has been requested are under consideration by the Main Committee, one of the most important being a suggestion for a Canadian Electric Code.

The officers of the Association are: Sir John Kennedy, Chairman; H. H. Vaughan and T. A. Russell, Vice-Chairmen; Dr. J. B. Porter, Hon. Secretary; and R. J. Durley, Secretary, room 112, Western Block, Ottawa.

The membership of the Main Committee is as follows:

Nominated by the Canadian Manufacturers' Association: Robert Hobson, Steel Co. of Canada; R. E. Jamieson, Dominion Rubber Co.; and A. R. Goldie, Goldie & McCulloch.

Nominated by Canadian Mining Institute: D. H. McDougall, Nova Scotia Steel Co.; Dr. A. Stansfield, McGill University; R. H. Stewart, Vancouver.

Nominated by Engineering Institute of Canada: W. J. Francis. Montreal; W. F. Tye, Montreal; H. H. Vaughan, Montreal.

Nominated by Advisory Council: Dr. Macullum, Chairman Research Council; Dr. J. C. McLennan, Toronto University; R. A. Ross, Montreal.

Nominated by Institution of Civil Engineers: G. H. Duggan, Montreal; Sir John Kennedy, Montreal; Dr. Porter, McGill University.

In addition three nominees each are appointed by the Universities of Toronto, McGill and Laval, and a number of ex-officio members represent various governmental interests.

Copies of the Bridge Specification, and particulars of the activities of the Association, can be obtained from the Secretary, Mr. R. J. Durley, at the address given.

Steel Wizards, Past and Present

By ALBERT SAUVEUR*

(An address before the American Society for Steel Treating.)

We are rightly proud of our achievements, of the wonderful steel industry of our country, of our leading position as the greatest iron and steel-producing nation in the world, but lest we forget what we owe to the steel wizards of other lands it will be salutary to recall their deeds. It will keep us from too complacent an attitude toward other metallurgical nations reporting smaller tonnage. It should stimulate in us a desire to contribute more substantially to the progress of the art in which we are interested.

We have been eminently successful. Our iron and steel industry has added vastly to the wealth of the nation. A book has been written entitled "The Romance of Steel; or The Making of a Thousand Millionaires." Our business men, our captains of industry, our financial wizards have played their parts most successfully. Can the same tribute be paid to our scientific and technical wizards? Have they played their parts, or have they been satisfied with following the tracks of wizards of other nations? Can they be accused of parasitic tendencies?

I should first describe what I have in mind by steel wizards. I mean those men who have contributed the great basic inventions upon which the iron and steel industry is founded — men like Huntsman, Cort, Reaumur, Bessemer, Abraham Darby, Tschernoff, Osmond, Le Chatelier, Sorby, Howe—men whose discoveries, inventions or scientific contributions are epoch making.

Our Contribution Chiefly Labor-Saving Devices.

Is it not true that although being by far the greatest iron- and steel-producing country we have not contributed our share of these great inventions, discoveries

*Professor of Metallurgy and Metallography, Harvard University.

and scientific achievements. Is it not true that our contributions have been chiefly of a mechanical kind, that they have consisted in the main in labor-saving devices and machinery destined to cheapen and speed up production? In this we have been undoubtedly successful and the importance of speeding up and cheapening production is not to be denied or belittled, but should we be satisfied with great advances in this direction only?

American mechanical wizards have passed through our steel plants and have left their marks, but do we not look in vain for evidences of the passage of American metallurgical wizards?

Is it not true, and is not the thought somewhat humiliating, that if all the contributions of American metallurgists and scientists to the art of making steel had never been made, iron and steel would continue to be manufactured, worked and treated practically as they are today, in reduced proportions to be sure, but of unimpaired quality? Is it not also true that if the contributions of English metallurgists and scientists were withdrawn the entire structure of the iron and steel industry would ignominiously collapse? We would have neither puddling furnaces, nor crucible steel, nor bessemer steel, nor open-hearth steel, nor rolling or forging appliances.

We make more pig iron than any other country, but the blast furnace was neither invented nor developed in the United States. We have discarded the expensive fuel charcoal, but this was first done by the Englishman Dud Dudley in 1619. We make more coke and use more coke for iron making than any other nation, but coke was first made and first used as a blast-furnace fuel in England by Abraham Darby, who in 1735 had the inspiration of treating coal as the charcoal burners were treating wood.

More waste gases issue from our blast furnaces than in any other country, and possibly we utilize them more thoroughly, but this has been made possible by the invention of metallurgists of other nations: by Aubertot in France, who in 1811 took a patent for the utilization of the waste gases; by James Beaumont Neilson of Glasgow, who in 1828 first suggested the use of hot blast; by Robert du Four in France and James Palmer Budd in England, who in 1833 and 1845 respectively suggested the heating of the blast by burning waste gases; by Philip Taylor in England, who in 1840 suggested the closing of the top of the furnace that the waste gases might be collected; by G. Parry of England, who in 1850 invented the bell and hopper or cup and cone as a means of closing the top of the furnace; and by the Englishman E. A. Cowper, who in 1860 introduced the use of regenerative brick stoves. We have now, I believe, a greater number of gas blowing engines than any other country, but the internal-combustion engine using blast-furnace gas was developed at Seraing in Belgium and we were at first quite reluctant to adopt it.

As notable improvements in blast-furnace operations we may claim, I believe, the automatic loading by skip cars and inclined planes and the double bell and hopper which that method requires.

We make more wrought iron than any other country, but the reverberatory puddling furnace was invented in England in 1784 by Henry Cort and the wet puddling process was introduced in that country also by James Hall and S. B. Rogers about 1830.

In the Steel Industry.

We have a very important crucible-steel industry, but crucible steel was first made by an English clock maker, Huntsman, in 1740, while the method we follow by which we do away with the necessity of using blister or converted steel was introduced by the Englishman Mushet in 1801.

We are making more bessemer steel than any other nation, but the bessemer converter and its necessary equipment was invented in 1856 by the illustrious Bessemer, An Englishman of French parentage, and the bessemer process was made successful by Robert Forrester Mushet, another Englishman who discovered the necesity of adding spiegeleisen or manganese in some other form.

The basic bessemer process, in which, to be sure, we are little interested, resulted from the masterly investigation and study of two Englishmen, Sydney Gilchrist Thomas and his cousin Percy C. Gilchrist, in 1878.

We make more open-hearth steel than any other country, but the regenerative furnace is not an American invention and open-hearth steel was first made by the French metallurgist Emile Martin in 1865.

We are, if I am not mistaken, making more electric steel than any other country, but we took practically no part in the development of the electric furnace for steel making, the furnace we most use being the invention of the French metallurgist Héroult.

We make more ferro-alloys and more special or alloy steels than any other nation, but the most important of these with the exception of high-speed steel we owe to the labor of metallurgists and scientists of other countries.

Our yearly tonnage of malleable castings is very much greater than that of any other nation, but the invention of the process is to be credited to the illustrious French chemist Reaumur, who described it in 1722. To him also we owe the first scientific study and disclosure of the cementation and case-hardening processes.

We roll and forge more steel than any other nation, but with the important exception of the three-high rolling mill, rolling and forging appliances were not invented by us. The two-high pull-over grooved mill was invented by Cort; the reversing mill in 1866 by Ramsbottom in England; the universal mill is a German invention; the continuous mill was invented in 1861 by the Englishman Charles White, although it has been much improved by the American engineers Bedson and Morgan. We owe the steam hammer to the genius of two Englishmen, James Watt and James Nasmyth, and hydraulic presses to the Englishmen Bessemer and Gledhill.

We treat a larger tonnage of steel than any other country, but can we claim that the scientific investigations which have lifted the art of treating steel to such high degree of perfection are due chiefly to American metallurgists and scientists? Is it not true that with the exception of the invaluable contributions of Prof. Howe the work has been done chiefly in Russia by Tschernoff, in England by Sorby, Roberts-Austen, Arnold. Stead and Rosenhain, and in France by Osmond, Le Chatelier, Guillet, Charpy, Portevin, Chevesnard and Grenet?

High-Speed Steel the Exception.

The discovery of high-speed steel, or, if you prefer, of the treatment imparting high-speed properties to certain steels, by F. W. Taylor and Maunsel White, I

am inclined to consider as our one epoch-making contribution to the metallurgy of steel. I am well aware that some have tried to throw doubts on the novelty of this discovery, but in my opinion their contentions are not only ungenerous but unjustified. It continues to shine as the brightest American star of the metallurgical sky.

America's Roll of Honor.

On a roll of honor for notable inventions, discoveries or improvements in the art of making, working or heating iron and steel or for notable and fruitful scientific contributions to that art, the following Americans are, I believe, entitled to a place:

H. H. Campbell, for designing the first tilting open-hearth furnace.

John Fritz, for his invention of the three-high rolling mill.

James Gayley, for conceiving and executing the drying of the air blown into blast furnaces.

A. L. Holley, for notable improvements in the construction of bessemer mills.

Henry M. Howe, for his invaluable scientific contributions to our knowledge of steel.

Robert W. Hunt, for his pioneer work in bessemer steel and in steel-rail manufacture.

W. R. Jones, for introducing the use of mixers in steel making.

Julian Kennedy, for notable improvements in the construction of blast furnaces and of blast-furnace equipment.

F. W. Taylor and Maunsel White, for their epoch-making discovery of high-speed steel.

Samuel T. Wellman, for notable improvements in the construction of open-hearth furnaces, for designing and constructing charging machines and other useful appliances.

Frederick W. Wood, for his introduction of the car-casting method for steel ingots.

Conclusion.

The natural conclusion of my remarks must be a wish that we may become more prolific in steel wizards of the first order—that is, in metallurgists who will not be satisfied in merely speeding up production through ingenious labor-saving and other devices, but who will bend their energy and talent toward the discovery of new and epoch-making methods of producing, working and treating steel that we may in future, as the leading metallurgical country, contribute our full share to metallurgical progress.

COKE BREEZE BURNED EFFICIENTLY

Showing Results Obtained After Tests on Burning Metallurgical Coke in Under-Feed Stokers*.

By A. H. BLACKBURN.

Coke breeze is a mass of fine abrasions obtained in the manufacture of coke. In amount it it usually about 6 per cent of the total coke produced. This refuse is variable in size, but screening will usually show 40 per cent passing a ½ inch mesh screen, and 60 per cent passing one of 1⅛ inches. But the finer particles, ranging from dust to ⅜ inches are too small to burn efficiently without special apparatus and therefore there is no demand for this size.

The heat value of coke breeze is very good, the average sample when dry showing between 10,000 and 11,000 B. T. U. Approximate analysis will show a rather variable composition as is shown in the following table.

	P.C.	P.C.
Fixed carbon	60	75
Volatile	5	8
Ash.	15	22
Moisture	4	20

Coke breeze is often used when mixed with coal and fired by hand. Naturally this would not give the very highest efficiency although it does effect an appreciable saving on the coal bill. Other plants have attempted to burn pure coke breeze or mixtures of coke breeze and coal on various stokers without much success. The fault lies mostly with the stoker. Usually the slope is too steep, or the fuel bed too thin, and other common features prove undesirable when burning this fuel. It soon became apparent to power plant engineers that a special stoker would become necessary to give efficiency with such light fuel.

After a series of tests one stoker was found to give excellent results with coke breeze as originally designed and that could be easily modified to give the very best results. This stoker is designed on the under-feed principle. The slight slope on the retort, only eleven degrees, give a reliable fuel bed; the fuel fed from underneath gives an even fire at all times; the automatic control gives a perfect control of fuel and air supply, and the constant movement of the bed prevents clinker formation. It was found that excellent fires could be maintained when using pure coal, different proportion of coal and coke breeze, or pure coke breeze, without any change in the stoker. The mixing was done in bins for the tests on this stoker, simulating natural conditions in any plant.

These advantages met the difficult requirements necessary to burn coke breeze. They are:

The mixing mechanism must be simple in order to accomodate conditions in existing plants.

Coke breeze mixtures must be held together so that the particles of coke may "freeze" thus permitting the air pressure to facilitate combustion. Holes in the fire and slippage of the fuel bed must be avoided.

The fuel bed should be kept fairly thin as otherwise heavy clinkers will develop, necessitating high air pressure.

Light air pressure is necessary as otherwise the fine particles of breeze are blown up into the baffling of the boiler or down onto the dump plate and holes in the fire develop.

The slope of the fuel bed should be slight as otherwise the coke breeze will accumulate thickly at the rear of the furnace, necessitating a great amount of burning on the dump plate, causing large clinker formation.

Due to the abrasive nature of the coke breeze moving parts are not desirable. Also the stoker construction should be such as to avoid an excessive amount of siftings dropping through into the air chamber.

As coal and coke pockets may form in the hopper causing an uneven fire in the furnace, flexible control of retorts permitting variable speeds of feed are desirable.

One test of this particular stoker that shows good results was run at a Michigan plant. The stokers tested were the Jones "A-C" multiple retort type. A mixture of 225 pounds of coke breeze to 100 pounds of coal was burned with an efficiency of 65.6 per cent at 155.5 per cent rating. Also with a mixture of 325 pounds of coke breeze to 100 pounds of coal. 141.1 per cent was developed with 59.1 per cent efficiency.

*Chief Engineer, Underfeed Stoker Co. of Canada.

Several prominent engineers in the steel industry witnessed these tests and were very favorably impressed by the results shown.

As far as was possible usual working conditions were duplicated. The simplest possible mixing scheme was used. Each component of the fuel charge was weighed separately and the coal and coke breeze were then mixed with shovels and fed into the hoppers. The coke breeze was very fine, ranging in size from dust to 3-8 inch. The stoker equipment was used as found, no alterations being made. It had been in service for about three years, and had been on the line for five weeks prior to the test, operating 24 hours a day with variable loads. The usual efficiency gave from 150 to 250 per cent of rating.

A similar test was made in 1919 by the Ford Motor Co. on a larger scale. Here the coal and coke breeze were stored separately and mixed by dropping alternate charges of each into a travelling bin, and fed from this into the hoppers. They obtained excellent results with a mixture of two parts coke breeze to one part coal. They are now using this mixture as their regular fuel with a great saving of money. Its use will be introduced in other installations in the Ford plant, particularly at their River Rouge steel plant.

Both tests described were conducted on stokers having an inside furnace length of 8 feet 7 inches, with the usual tuyere block openings. It is believed that still better results might be secured on a longer stoker, say of 10 feet 4 inches in length, and by the use of more tuyere block openings. This latter feature, naturally, would permit a greater volume of air at low pressure to be admitted into the fuel bed. This would tend to increase materially the ratings and efficiencies obtained.

The Use of Ontario Iron Ore for Canadian Furnaces

Paper Read Before the Canadian Institution of Mining & Metallurgy.—Winnipeg, 27th October, 1920. Reproduced by Special Permission.

By Capt. H. E. Knobel.

The subject of Iron and Steel is such a comprehensive one, that it would be impossible within the scope of a short paper, to more than touch on one phase of it. What I shall endeavour to do, is to show that there are almost unlimited supplies of low grade iron available in Ontario, which could be made merchantable and suitable for furnace practise through beneficiation—the term used to denote some preliminary treatment to increase the metallic contents or eliminate deleterious constituents. No information about this can be found in the Government reports, which are not only quite incomplete, but totally fail to appreciate the potential value of such deposits.

Two notable instances of beneficiation are already in operation in Ontario, one at the Magpie Mine in the Michipicoten District where Siderites running 35 p.c. Fe are calcined and raised to 50 p.c. metallic contents; and the other at the Moose Mt. Mine, where banded magnetites running 37 p.c. in iron are magnetically concentrated to a product of 63 p.c. Fe.

It is quite unnecessary to stress the importance of the Iron and Steel Industry of a country and the relation it bears to its prosperity. It has become an axiom. If any proof were needed of such, that proof has certainly been furnished during the war. Germany's iron resources were fast coming to an end and it was the annexation of the Brieux Basin in the French Lorraine that she was primarily fighting for. This would have made her independent of foreign importations of ore, and crippled the industrial future of France at the same time. No discussion of Iron and Steel can take place without referring to coal; the two subjects are inseparably related, and in that connection it is interesting to note that the loss of the Saar Valley, which is at present being administered by one of your fellow citizens, is probably the bitterest blow Germany has to content with. That is the picture on one side of the Atlantic.

On this side of the ocean, altho Canada has built up a substantial Iron and Steel Industry, she stands alone in the unique and unenviable position of being the only portion of the British Empire that has not developed her own iron ore resources and scarcely touched her coal. The necessity of her so doing has not in the past been so apparent. She probably followed the line of least resistance. The Atlantic furnaces procure their coal locally and their ore from the inexhaustible deposits of Belle Isle, Newfoundland. They also own the mines and the ore comes from a sister colony. On the other hand, with the exception of a small percentage of ore that comes from the Michipicoten District, the Ontario furnaces derive all their supply of both iron and coal from the United States.

At the present time, less than 5 p.c. of the ore smelted in Canada is of domestic origin, and yet nearly $200,000,000 worth of iron ore and iron and steel products are imported annually.

All these facts are so well known and have of late so often been brought to the attention of the public and the Government—through the Press and by resolutions from Boards of Trade and Mining Conventions,—that I only repeat them by way of introduction to a special plea that vigorous action be taken to place the country on an independent basis in-so-far as a domestic source of these raw materials, iron and coal, is concerned. Until this has come to pass, Canada can never be considered to have fully entered into the nationhood, that the part she played in the war entitles her.

Ontario Iron Ranges.

In making a brief survey and necessarily very rough estimate of some of the Iron Ranges of Ontario, I am going to confine it to those that are tributary to the Great Lakes and are tapped by the Canadian National Railway. Probably comparatively few people are interested in iron ore, but no citizen of the country can help but be interested in the future of the National Railway. It is safe to say, that there is no single factor that would do more to bridge the gulf between the East

and the West—that 900 miles stretch from Sudbury to the Manitoba boundary—than the development of the iron ranges that extend over a large part of its length —and there is no class of freight that would be so remunerative to the Railway as the carrying of large tonnages of ore.

Speaking generally, it may be stated that up to date, no high grade ores have been found. It has frequently been remarked that the International Boundary seems to divide riches from poverty insofar as iron ore is concerned, and this is generally ascribed to the greater erosion from glacial denudation that the Canadian deposits have undergone. This probably is partly true, but the fact that bodies of iron ore were able to survive up in Hudson Bay,—like those of the Nastapoka Sound, Belcher Islands, and Sutton Mills,—where glacial action must have been more intense, is some proof that the loss through this has been exaggerated. It must be remembered that with the exception of some magnetite deposits which do appear on the surface and are hard enough to have withstood erosion, concentrations of iron ore are mainly subsurface occurrences, depositions in synclinal folds and pitching troughs, and even where they may have originally appeared on the surface, due to their comparative softness, they may be expected to be found beneath swamp and lake areas, and frequently covered with drift.

Two of the ore occurrences on the south shore of Lake Superior were found to outcrop, but it was by following the lean siliceous and magnetite parts of the iron formation, which had withstood erosion, that ores were finally discovered by underground methods.

Up to 1911, 7,200,000 ft. of diamond drilling had been completed on the iron ranges on the south shore of Lake Superior in exploring for high grade ores, in comparison with only 50,000 ft. of drilling in the Thunder Bay District. This probably, in part, accounts for the absence, so far, of high grade ores on the Canadian side, but a further reason is most likely to be found in the fact, that with the exception of the Loon Lake deposits, which are an eastern extension of the Mesabi range, all the ores so far found are of Keewatin age, which has proved to be less prolific in high grade concentrations that those in the Lower Huronian or Animikie series.

Starting from Moose Mt., on the east, an immense tonnage has been demonstrated of banded magnetites running about 37 p.c. iron. These are treated with fine grinding in the Grondal Process and yield briquettes averaging 63 p.c. metallic contents with a 2 to 1 concentration.

Similar bodies of ore are also found at Burwash and Onaping. On Shagatoska Lake, north of Biscotasing, some 20,000,000 tons of high sulphur ore averaging 55 p.c. Fe and about 16 p.c. S, have been proved up by diamond drill. These make an excellent product when roasted.

From Little Long Lake to the east shore of Nepigon Lake, three promising areas exist showing large bodies of jaspilite ores averaging from 35 to 45 p.c. metallic contents. One outcrop on Little Long Lake averages 43 p.c. Fe over a width of 400 ft.

At Loon Lake, east of Port Arthur, the ore beds are composed of high grade hematite interbanded with lean taconite. The ore is readily hand sorted and yields 2 tons of merchantable product from 3 tons of material. On the McConnell property over 4,000,000 tons have been proved by diamond drill,running when sorted from 50 to 55 p.c. metallic contents, and of Bessemer grade. The whole field, it is estimated, may produce 25,000,000 tons of an extremely desirable and low phosphor ore.

The Kaministiquia, Conmee Township and Mattawan ranges, west of Fort William, show immense outcrops of banded jaspilites, averaging 35 p.c. Fe, and better. Tests made with coarse crushing, using 1/4'' mesh, and jigs, have produced a concentrate running 50 p.c. Fe with a 2 to 1 concentration.

On the Atikokan Range, east of Sabawe Lake, the Atikokan Iron Mine has proved by development and diamond drill some 10,000,000 tons of ore, averaging 55 p.c. Fe, 2 p.c. S, and .1 p.c. Phos. They have shipped up to date 86,433 tons running 59.85 p.c. Fe, 2 p.c. S, and .11 Phos.

West of Sabawe Lake some 15,000,000 tons of high sulphur ore has been demonstrated by drill, averaging 55 p.c. Fe, 13 p.c. S and .03 Phos.

A test shipment of 400 tons analyzed after roasting 65.53 p.c. Fe, .02 p.c. Phos., 3.44 p.c. Silica and .59 Sulphur, which is a very excellent example of what beneficiation can do to an ore.

An approximate estimate made by the United States Geological Survey of iron bearing formation on the Canadian side, tributary to Lake Superior and exclusive of the Michipicoten District, placed the reserves at nine billion tons that would run 35 p.c. iron content, or better.

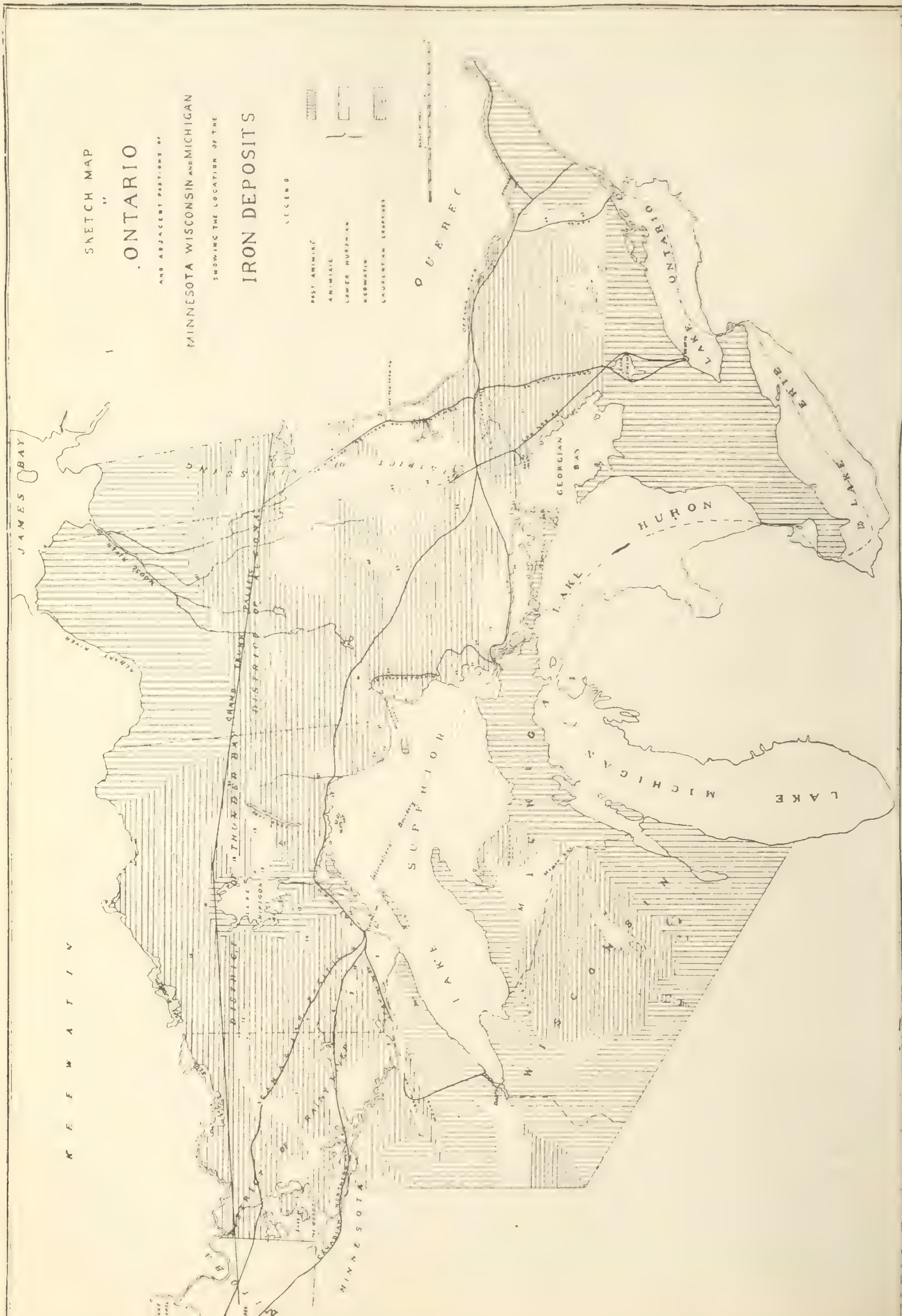
The largest proportion of these ores are jaspilites,—mixtures of magnetite and specular ore banded with a siliceous gangue. Experiment has shown that there is no physical difficulty in making a successful concentrate of such ores, where the individual bands of ore are of merchantable grade, and where they separate cleanly from the gangue and do not require fine crushing for the operation. Those that are more intimately mixed necessitating fine crushing, are then best treated by a preliminary magnetic roast and magnetic concentration.

Whatever the form of beneficiation, whether it be handpicking, jigging or some other form of wet concentration, — magnetic concentration, — calcining or roasting, it is of course done at an added cost to the final product.

The representations that have been made to Parliament by those interested in the Iron Industry for a bounty on Iron Ore, have had in view the fact that practically all Canadians ores require some form of beneficiation to make them merchantable and that can only be obtained at an added cost. The expenditure on labour and supplies necessary for the production of the ore and the profits to be derived from its transportation would repay the country many times whatever the bounty entailed.

American Ore Resources.

Turning to the American side, the source from which we derive our ores—it is computed that the reserves of ore of merchantable grade in the whole Lake Superior region, will be exhausted at the present rate of consumption within about 25 years,—a small period compared to the magnitude of the industry. When these reserves begin to fail, it is not to be expected that, however, cordial the relations between the two countries may be, it will extend to dividing up their stock piles with us. I particularly emphasize the cordial relations that exist between the two countries at the present time, but it would be obviously the part of wisdom to prepare for the day when that relationship may possible become less cordial or even hostile.


SKETCH MAP
ONTARIO
MINNESOTA WISCONSIN AND MICHIGAN
IRON DEPOSITS
JAMES BAY
KEEWATIN
QUEBEC
LAKE ONTARIO
LAKE ERIE
LAKE HURON
GEORGIAN BAY
LAKE MICHIGAN
LAKE SUPERIOR
MICHIGAN
WISCONSIN
MINNESOTA
THUNDER BAY
RAINY RIVER

If there is already a feeling in certain quarters that the diminishing supply of anthracite should be conserved for the benefit of the country that raised it, there is nothing unreasonable in expecting a similar attitude towards iron ore. Unless in the meantime further discoveries of merchantable ores are found, the American furnaces will then be dependent on ores similar to our own, which on account of their leanness or deleterious constituents, require some preliminary treatment or beneficiation to make them suitable for furnace practise. In order to provide for this contingency, on the experience gained in an experimental plant erected at Duluth, a plant of 3,000 ton capacity is now being erected and will be in operation next season, at Babbitt, Minnesota, to treat magnetite ores containing only 20 to 30 per cent metallic contents. This should serve as an example of what can and should be done on this side of the line, with the ores, of which I have given you only a rough summary, and many of which contain considerably higher percentages of iron than those that will be treated at Babbitt.

Smelting of Iron Ores.

The question of the smelting of iron ores necessarily entails a discussion on coal, or its substitute, electrical energy. The region in which the iron ranges occur is without fuel resources but is provided with abundant water powers. The direct reduction of iron ores and conversion into steel in the electrical furnace is only likely to be economically successful in very exceptional circumstances.

Coal, of every grade of excellence, is obtainable in Alberta, but transportation costs prohibit its use in competition with American coal to points on the Great Lakes.

The most probable solution of the problem of utilizing domestic supplies of both iron and coal would seem to be in the nature of a compromise by employing carbon fuel only for the reduction of the ore to the metallic state and using electrical energy for the final high temperature treatment. The extra transportation charge by using Alberta coals for the comparatively small quantity of carbon fuel necessary, would then be of less consequence. It must be remembered that the largest single item of cost of the final product is the one of transportation, which is the total cost of transportation necessary to bring together all the ingredients of a furnace charge, coal, limestone and iron, and to transport the finished product to the consuming areas, As the balance of power shifts west and the main consuming areas are the three prairie provinces, the apparent disadvantages of using Alberta coal may disappear.

Where Iron and Coal meet, where there is ample supply of cheap hydro electric power, and where the manufacturing and distributing centre lies at the doors of the consuming areas, there will eventually be found the Metropolis of the Iron Industry.

Academic discussions of such subjects as this fail, unless they are supplemented by vigorous representation of some constructive policy.

In that connection, I would submit that Government assistance be petitioned.

First, for a suitable bounty on all Canadian iron ores mined and marketed without restriction—payable to the mine operator, to ensure that it is the miner of the ore who will receive the benefit—and to be operative over a sufficient period of years to make the exploration for the iron ores, the development and operation of the same, an attractive proposition to capital.

Secondly, for the installation, at some suitable point, of a concentrating Unit, on a sufficient scale to make economic determinations, for the beneficiation of jaspilite ores, those that are most representative of the large reserves of low grade ores available.

I believe that both these suggestions will meet with your approval and I have very good reason to believe that they will be entertained with a sympathetic hearing at Ottawa.

To summarize the problem of an Iron and Steel Industry for Western Canada, utilizing a purely domestic source of both iron and coal—the salient points would seem to be these:—

1. There are undoubtedly immense tonnages of low grade ores available, tributary to the Great Lakes and provided with transportation by the Canadian National Railway.

2. That these ores can be raised to merchantable grades and rendered suitable for furnace practise by various methods of beneficiation.

3. That a ready market can be obtained in many instances for the waste rock eliminated by the process of beneficiation, for purposes of concrete road metal, or ballast.

4. That excellent water power for production of electrical energy exists throughout the region.

5. That the absence of carbon fuel can be probably minimised by a combination process of reduction to metallic state by pulverized coal and final treatment in an electrical furnace.

6. That Alberta coals could be used for this purpose owing to the comparatively small percentage of carbon fuel required, even with existing methods of transportation.

7. That the proximity to the markets of the three Prairie Provinces ensures an advantage for the product over Eastern Furnaces.

I have attempted to make out a case for the Western Iron and Steel Industry. If any further argument were necessary, it would be to point to the adverse trade balance of $192,000,000 of imports over exports during the fiscal year of 1919-1920 of mineral products, chiefly iron an coal, the loss in exchange alone amounting to $40,000,000. The farming community of these provinces may not be very interested directly in an Iron and Steel Industry, and the ways and means by which the Government could aid in establishing one, but they are paying their due proportion of that $40,000,000.

NOVA SCOTIA MINERS' WAGES.

Representatives of the U. M. W. of A. from the Nova Scotia District, accompanied by John P. White, of the U. M. W. international headquarters were in conference most of the week ending November 6th at Montreal, and at final meetings on the 9th it is understood that a tentative settlement of the wage question was arrived, pending ratification by the members of the union after the case has put before them by the leaders. The nature of the settlement has not been divulged, but it is understood to be a compromise on the findings of the Royal Commission, and the principal consideration was the admittedly harmful effect any further large increase in coal-miners' wages would have upon the ability of the Nova Scotia companies to hold their markets and keep the steel plants in operation.

The Case for a Bounty on Iron Ore Mining in Canada*

Iron Ore Mining, and an Adequately Developed Iron and Steel Industry, are Essential to Industrial Independence in Canada

The present status of iron ore mining in Canada is in anything but a satisfactory condition, considering the enormous bodies of iron ore within its borders.

The majority of the known deposits are what is known as low-grade ore, and require more or less treatment to bring them to merchantable grades, to meet furnace requirements.

The general classification of low-grade ores contain all non-merchantable ores. On the basis of iron content, they may be classified as follows:

1. Ores containing less than 40 p.c. of natural iron.
2. Ores containing between 40 p.c. and 50 p.c. natural iron that are used to some extent at the present time as concentrating ores, or are mixed with ores of high iron content, in order to increase the tonnage.
3. Ores containing over 50 p.c. natural iron that are not of the necessary physical structure to meet demands of furnace practice.

The necessary treatments take the form of magnetic separation, roasting, calcining, grinding and briquetting, and are collectively known as "beneficiation". All of these forms are well known to metallurgists, and have been brought to a high degree of perfection, especially on the iron ranges of Minnesota, where enormous sums have been expended in exhaustive experiments to demonstrate the commercial feasibility of magnetic separation, and other forms of beneficiation, with results that are so highly satisfactory that millions of dollars are being expended in the construction of plants for the exploitation of low-grade magnetites, averaging between 25 p.c. and 30 p.c. natural iron content.

The Mesabi Iron Company expended $750,000 in testing magnetic separation, in an experimental plant, at Duluth, Minn. on ores of this character from the Eastern Mesabi range, and are now constructing an operating plant at Babbitt, Minn. the first unit of which, will entail an expenditure of $3,000,000 and have a capacity of 3,000 to 4,000 tons per day. They are laying out a town on broad and permanent lines at this point, including all modern conveniences for a large force of operatives, metallurgical and office staffs, showing their confidence in the future outcome of their enterprise. This plant will be in operation this Autumn, and will enter the shipping class on the opening of navigation in 1921. It is fully expected that it will be a prominent factor in iron ore shipments from Lake Superior in the years to come.

This undertaking is being carried out by experienced metallurgists and iron ore mining operators, after thoroughly satisfying themselves that ores of the low iron-content mentioned above, can be mined, treated and placed on the market, in a form to meet the highest furnace requirements, at a profit, in competition with the high-grade ores of the Mesabi range. The efficiency of the machines developed in the Mesabi Iron Company is such, that the concentrates can be perfectly controlled, from the lowest grade, up to 72.4 p.c. iron content, thus enabling them to meet any furnace demand. The concentrates are produced in the form of a porous sinter, a most desirable form for furnace use.

The iron deposits of Northern Ontario are very similar in character to the low-grade ores of the Eastern Mesabi, and are largely amenable to the same form of treatment. Therefore, we should consider ourselves fortunate, that experience and responsible individuals, have successfully carried the beneficiation of low-grade magnetites through the experimental stage, and set the pace for what may be done with similar ores in Ontario.

Canada has immense quantities of beneficiable ores in the prospected parts, more particularily Northern Ontario, that are known to contain many millions of tons, at points traversed by the Canadian National Railway, the Canadian Pacific Railway, and the Algoma Central Railway. This will obviate a large initial expenditure for transportation facilities, which, ordinarily have to be overcome in the development of new iron fields.

Estimates, based upon diamond drilling, place the quantity of ore in certain Northern Ontario deposits at figures ranging from 100,000,000 tons downward. In other provinces of the Dominion, there are very large, but less definitely measured, possibilities in available ore.

In this connection, it may be pointed out that only about 50,000 feet of diamond drilling has been done on the Ontario ranges, as against some 10,000,000 feet on the Minnesota ranges. Drilling so far carried on, has resulted in disclosing large bodies of good merchantable ore, where only lean jaspilites showed on the surface. It may reasonably be assumed that further, and sustained drilling will locate other valuable deposits, when iron ore mining receives the encouragement that is its due.

Statements covering details of tonnage of the various Northern Ontario and other ranges, are included in an appendix hereto.

Our known deposits of iron ore thus represent supplies for years to come. The potentialities of the unprospected portions of the Dominion are enormous.

Iron ore mining in Canada is confined to Northern Ontario. The Algoma Steel Corporation, Ltd., operating the Magpie Mine, producing siderite ore, and the Moose Mountain Ltd. operating magnetite properties in the District of Sudbury, constitute the only activities in iron ore operations. Both these companies have extensive reserves of ore, proven by diamond drilling and milling development work. Both companies have carried beneficiation processes to such an extent, that they are convinced, that with reasonable Government aid, these low-grade ores can be profitably converted into marketable grades.

This has been arrived at, only after an extremely large expenditure, and is highly significant of what the possibilities are in beneficiating low-grade ores. It shows that under proper encouragement, Canada

* A memorandum presented to the Tariff Commission at Port Arthur, 16th October, 1920, by J. J. O'Connor.

may produce sufficient domestic ore to displace the United States ore we are importing at the present time.

Canada's imports of iron ore has passed the 2,000,000 ton mark annually. Imports of iron and steel products for the year ending March 31st, 1920 reached the enormous figure of $189,907,602. With an extensive railway mileage, years in arrears for betterments, and necessary upkeep, after six years of almost complete cessation of all classes of constructive development. With the necessity of catching up these arrears, and meeting the growing wants of our fast developing country, the imports of iron ore, and iron and steel products, may reasonably be expected to increase, unless active steps be taken to develop a domestic iron and steel industry, and displace the imported ores, and iron and steel products by our own resources.

The tonnage of domestic ore charged to furnaces in Canada, has fallen from about 300,000 tons in 1915, to less than 100,000 tons in 1919, or about 5 p.c. of the total tonnage smelted. Of the total of 653,137 tons of ore charged to 7 blast furnaces in Ontario, for the six months ending June 30th, 1920, only 58,387 tons were of domestic origin, the balance being imported from the United States. Exports of domestic ore are negligible.

What Iron Ore Mining Means to Canada.

It is quite obvious that the successful operation of iron mines means more that the employment of so much labour. It implies a maximum of activity in all lines of endeavour, a continuous flow of freight traffic, so necessary to our National Railways, the erection of steel works, by-product plants, wire, and wire nail plants, slag-cement works, and all classes of industries subsidiary to iron and steel works. It also implies the upbuilding of prosperous communities in the agricultural areas surrounding the iron ore deposits. The magnificent stretches of arable land in the great clay belt of Northern Ontario will be brought under cultivation, with markets provided by an iron mining industry. No class in the community will receive greater or more direct benefit that the farmer.

An iron and steel industry, on an adequate scale, will do more to solve the tariff problems of the former in Canada, than anything that could be done in his behalf, by way of tariff changes. We can never hope to have cheap agricultural machinery while we are obliged to import raw material in the vast quantities we are now doing.

If trade and commerce in Canada is to be put on a sound foundation, it is plain that this must be built up on a combination of the two great basic industries, of mining and agriculture.

Canada has done her part well in the upbuilding of the blast furnace industry, in granting $17,000,000 in bounties during the period of 1896-1912. Without these furnaces, Canada would have been in a sorry plight during the Great War. While they have been, and are doing splendid service, they have been built up at the expense of the neglect of our own ores. This can be accounted for, largely from the fact of the easy accessibility of United States high-grade ores, and the further fact, that beneficiation had not been brought to the high state of perfection it is in today.

There are many reasons why Canada should take definite and immediate steps to develop an iron ore mining industry, some of which may be briefly summarized as follows:

1. The vital necessity of establishing an iron and steel industry on a stable basis, in order to secure the industrial independence of Canada in the matter of iron ore.
2. The development of our vast resources in iron ore, as a means of defraying the tremendous financial obligations created by the war, the profitable development of our gigantic railway system, and the improvement of the water-ways of the Dominion.
3. The Canadian National Railway traverses four-fifths of the iron ore deposits of Northern Ontario, and would be immediately and directly benefited by the increased traffic developed by an iron mining industry. The product of the mine may be made the largest single source of railway traffic in Canada. In the United States, the mining industry contributes between 55 p.c. and 60 p.c. of all freight moved. Iron ore mining contributes a larger volume of freight traffic than any other branch of the mining industry.
4. To produce from its own ores the plates necessary for the construction of the ships of Canada's Merchant Marine, a branch of industry vital to the future prosperity of the Dominion, if a profitable and successful export trade is to be built up, and to enable Canada to take her old place in the world's shipping lists in the matter of registered tonnage, that she occupied at Confederation.
5. To furnish the traffic necessary to keep the ships of Canada's Merchant Marine profitably employed in exporting manufactured articles to world markets.
6. To solve the farmers' tariff problem, by the manufacture of cheaper agricultural machinery,

more and more of which will be required as the west develops.

7. The development of Northern Ontario's iron ore resources would do more to wipe out the "East and West" in Canada, than anything else that could be undertaken. It would form a complete union of the two geographical sections.
8. It would materially decrease imports, right the balance of trade, and stabilize exchange.

While Ontario's iron ore resources have been more particularly referred to in this memorandum, these reasons apply with equal force in every Province of the Dominion.

Needs of an Iron Ore Industry.

As mentioned above, the iron ores of the Ontario ranges require some form of treatment to bring then to grades suitable for furnace use. The cost of this treatment varies with the different grades and qualities found in the Canadian ranges. To place Canadian iron ore operators on a parity with United States producers, some form of Government aid is vitally necessary to enable them to overcome the cost of the necessary beneficiation.

The Dominion Government has been memorialized by a larger number of Boards of Trade, Municipalities, Mining and other Industrial organizations, praying for the granting of a subsidy, to cover a period of fifteen years, of a fixed sum of seventy-five cents per ton, on all Canadian iron ore mined and marketed without restriction.

If Government aid to the extent of seventy-five cents per ton, be granted on all iron ore mined in Canada, it would immediately make possible the development of the immense deposits of low-grade magnetites, hematites, and siderite ore of the Northern Ontario ranges. As iron-ore mining is now at such a low ebb in Canada, the amounts accruing to iron-ore operators under this system, would be very small for the first few years, as it would take some time to equip and develop ore lands, before the shipping stage could be reached. The amounts payable thereafter, depending as they do, on ore actually mined, beneficiated, shipped and sold, will simply be a measure of the growth of the industry. The larger they are, the larger will be the benefit to the country generally, as the subsidy would bring about disproportionately large returns in the stimulation of industrial activity.

Tangible assistance of seventy-five cents per ton on all Canadian iron ore mined and marketed without restriction, will unquestionably induce widespread activity in iron ore mining in Canada. The subsidy should be:

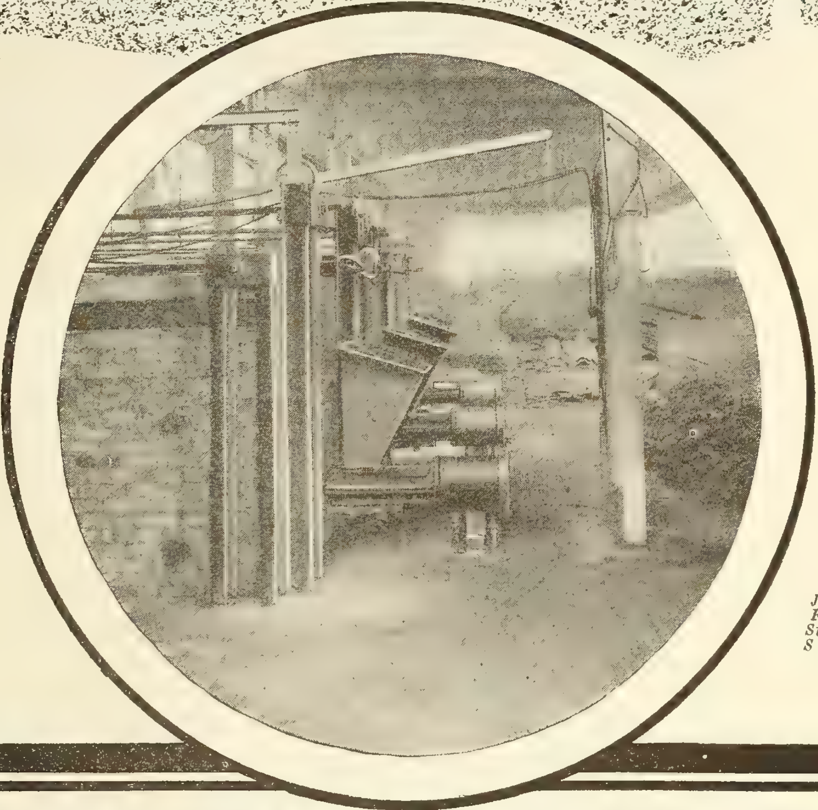
(a) In force for fifteen years.

(b) Paid monthly to mine operators.

(c) Reckoned (1) when the ore is milled or treated, on the long ton weights going into the milling or treating process; and (2) when not milled or treated, on the long ton shipping weights going to the furnace.

Necessity for Utilization of Our Low-Grade Ore.

The Province of Ontario is wholly dependant on the United States Lake Superior ranges for its supply of high-grade iron ore. The enormous tonnages of these ores that are being mined, shipped and smelted—between 55 and 60 million tons annually—naturally suggests the question: How long will these ranges hold out an available supply of high-grade ore for Canadian furnaces? The terrific drain on their resources must, within a measurable length of time, bring them



Jones Stoker Fired Furnace for Steel Bars and Shapes.

Highest Combustion Efficiency Means Lower Costs and Better Heat Treating

THE temperature of industrial heating furnaces can be closely regulated and held within close limits with Jones Under-Feed Stokers.

Fuel is fed automatically, and can be adjusted to any requirement. Air is automatically supplied in proportion to the coal feed, and in the exact amount to insure highest combustion efficiency. Since combustion is complete, the flame produced is smokeless and coal cost is a minimum.

The unequalled simplicity of Jones Stokers makes maintenance extremely low. Operation is simple, so that no skilled labor is needed. No doors to open—no chilling drafts through the furnace. Adaptable for every type of furnace, burning any grade of coal.

Our new booklet, "Industrial Heating Furnaces" shows many typical installations and contains much furnace data of value.

The Under-Feed Stoker Co. of Canada, Ltd.

81 Victoria St., TORONTO

JONES STOKER

to the point of depletion, insofar as the high grade material is concerned. It would seem, therefore, that Ontario ores must, at no distant date, be called upon to supply the furnace requirements of this province. It is but the part of sound economy to be prepared for that eventuality. The only means of reaching that stage, where we will have an abundant supply of our own ores, is through Governmental assistants by way of a subsidy, to offset the costs of beneficiation.

When the utilization of our low-grade ores is undertaken, it must be on a large scale, with large plant units, capable of handling large tonnages daily. The plants must be built in the most substantial manner, equipped with machinery that will operate efficiently and continuously, under heavy loads, with a minimum of personal attention. This requires a large investment of capital, that can only be induced to take up the enterprise, with the Government assistance above referred to. These plants will require to have heavy and costly machinery installed, most of which, would have to be imported, on which, the Government should remit the duty, as a further measure of assistance.

To show that the references to the high-grade ore supplies of the United States Lake Superior ranges, have not been overdrawn, I beg to quote Prof. Edward W. Davis, of the Minnesota School of Mines Experimental Station, University of Minnesota, Minneapolis, Minn., in Bulletin No. 7, May 22nd, 1920 in "The Future of Lake Superior District as an Iron Ore Producer:"

> "It is, of course, recognized by everyone, that at some future date all of the merchantable ore will have been removed from the district. This date is placed by various estimators at from 15 to 30 years hence. This statement is based on the assumption that the present rate of shipment will continue until the end of the season of the last year. This, of course, cannot be the case. The history of any successful mining district shows that during the first few years of life, small tonnages of high-grade material are mined. As time passes, and a district is more largely exploited, the tonnage mined each year increases. As the tonnage increases the grade of the ore usually becomes lower. After a certain time, the yearly production reaches a maximum, and after the maximum is passed, the production gradually decreases. The rate of decrease is quite rapid at first, but absolute depletion may not occur for many years. The distribution of the Lake Superior ores among the various furnace companies shows that, while some companies have a sufficient supply or ore to last them 30 or 40 years, other companies have enough to last only 5 or 6 years. These companies are already looking about for new sources of ore supply, and if they are not found in the Lake Superior district, the companies will go elsewhere."

It may thus be seen that the present source of supply of high-grade ores for Ontario furnaces, have but a comparatively few years of expected life.

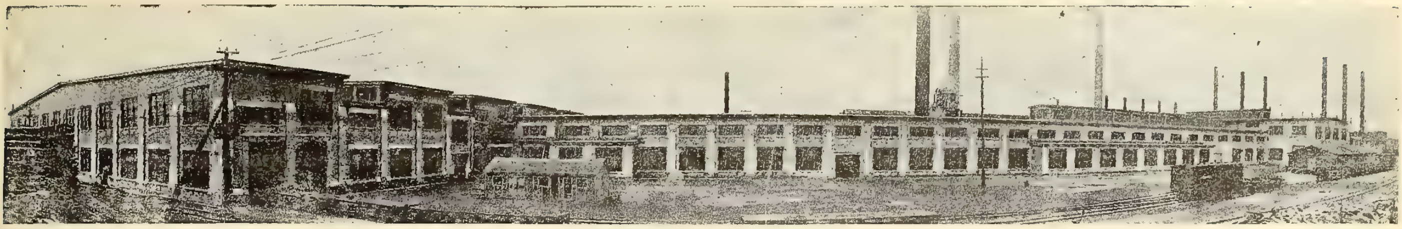
Electrical Development

Northern Ontario is in the fortunate position of possessing an abundance of water powers, that, on development, must play a considerable part, and be an important factor in the development and utilization of our iron ores.

The Nepigon River, in the District of Thunder Bay, is now under development by the Hydro Electric Power Commission, of Ontario. This River has a capacity of 200,000 H.P. of electric energy. The two first units of the present development will be ready for distribution at the Head of the Lakes, December 15th, 1920, followed by a further distribution up to 75,000 H.P. early in 1921.

When these powers are linked up with the modern methods and processes, for metallizing, and furnacing by electricity, already designed by a Canadian metallurgist, Mr. James W. Moffatt, of Toronto, we may reasonably look for the creation of a stable iron and steel industry, based on domestic ores, at an early date, provided the suggested aid be given by the Government.

These water powers are so located throughout Northern Ontario, as to be within easy access of all the iron ore ranges from the District of Rainy River on the west, to the most easterly deposits in the Districts of Algoma Sudbury.



EDITORIAL

The Steel Trade Outlook

The steel trade at this time is in a very similar position to that of the coal trade in the early part of 1919. At that time there was the appearance of an over-production, but actually there was the reality of a shortage. The deception was caused by abstention from buying, based on the unwarranted hope of a reduction in coal-selling prices, the ability to abstain from purchasing by large users, such as railways and public utility companies, arising from the general using-up of stocks. The immediate effect of this deliberate lessening of demand was idleness at the collieries during the Spring and early Summer of 1919, and a rush for coal during the Autumn. Demand was therefore least insistent when the collieries could furnish the coal, and most insistent when, largely from the effect of weather conditions upon transportation, the collieries were unable to make deliveries.

The underlying factor causing the rebound of coal demand after its artificial suppression in North America, was the world shortage of coal, the continuing existence of which is generally admitted, requiring no evidence to be adduced in proof.

Now that production of coal in the United States is being maintained at a satisfactory level, and the war-time stimulation of steel demand has entirely disappeared, the true post-war level of coal selling-prices in the United States is becoming apparent. In regard to bituminous coal adapted to use in steel manufacture, the cost of production will now range around $2.50 to $3.00 per ton, which compares with from $1.00 to $1.75 before the war, representing a post-war level of production cost of at least $1.50 higher than the pre-war level.

Respecting the future trend of the curve of coal costs, we surmise that it unlikely ever again to dip permanently below the present level of production costs, (selling prices are another story) but the chief uncertainty is the period for which the present cost level will persist before it again resumes the upward trend. Nothing is more certain in modern trade economics than a definite and unremitting persistence in the upward trend of the cost of coal production. This statement is based on premises of physical factors, of certain predictable effect, and does not take into account political or social tendencies that are, of course, unforeseeable.

Recent high prices for coal in the United States reflect local shortage of coal arising from transportation deficiencies, speculation in "spot" coal, profiteering and disorganization of distributing agencies. Recent declines in coal selling-prices represent closer approximation to pitmouth prices, some recovery in distributing efficiency, and an increase in production made possible by the ability of the railways to take the coal from the collieries and permit the miners to work more steadily.

It may be surmised, therefore, that coal prices and coal production are now stabilised on a peace-time basis, so far as bituminous coal is concerned. Anthracite does not concern the steel maker.

A diagnosis of the future course of the steel trade may be deduced from analogy with past events in the coal trade, because steel prices must always follow the rise and fall of coal prices.

It appears probable that while there is at this time an appearance of over-production in steel, the reality is that a definite shortage exists, and that, as was the case with coal, there is an artificial suppression of demand based on the hope of lower prices in steel, or at least on the emergence of a steel selling-price that will represent the post-war level of steel based on a similar level of coal cost, wages and transportation charges. This is what is meant by the term "stabilization."

Just so soon as the public makes up its mind that the selling price of steel and steel products represents that permanently higher notch in cost of post-war days, when compared with the dead and forgotten figures of pre-war times, the rebound in steel demand will come just as quickly and insistently as it came in the case of coal.

As the artificial, and, as it afterwards plainly appeared, unwise slackening of coal production in 1919 had the effect of bringing the actual underlying factor of shortage to public attention; so the existing sixty per cent, or smaller, rate of steel production now prevailing, and the likelihood of still further contraction in pig-iron and ingot tonnages during the remainder

of the Winter, will, we believe, disclose quite unmistakably a latent demand for steel and steel products of large volume. It can hardly be otherwise. For seven years in Europe, and in Canada, and for four years in the United States, there has been a restriction in prosecution of the arts of peace, in such matters as railways, highways, bridges, public buildings and housing in all its gradations, that must and will be overtaken.

While Europe is proceeding towards convalesence, it is doing so more slowly than the most pessimistic of prophets foresaw two years ago, and the Russian patient is sicker than at any previous time. This is the most deterrent feature to recovery of the steel trade in North America, for while the disorder that persists in Europe is daily adding to the world's shortage of steel, and daily bringing about destruction of articles and structures of steel and iron, it is also daily lessening Europe's ability to pay for imported goods, and making it less profitable for industries on this side to sell their products in exchange for the depreciated paper money of European nations.

The avoidance of entanglement of North American nations in European affairs is as possible as the escape of the Earth from the attraction of the central Sun. If the European nations can maintain social order and quickly restore their industrial fabric, the outlook for the steel trade is excellent, and its healthy revival is imminent. If, on the other hand, popular disorders should spread in Europe, then the revival of steel demand will be correspondingly delayed.

Protective Tariffs and costs of Livelihood

The Freetrader affirms that tariffs on imported manufactured goods restrict the growth of primary industries by raising the costs of livelihood of the workers.

Put in another way, the argument is that the whole evil of import tariffs resides in the high rate of wages necessitated by the tariff impost, which forbids the full use of labor in the production of basic raw materials. This is to predicate that the first desideratum for the production of such commodities as wheat, potatoes, coal and iron-ore is cheap labor.

Actually, however, it is not the cheapness of labor, but its abundance and its quality that determines the cost of producing primary materials. Relative to the United States, we have always had cheap labor in Canada, but the condition has not been one that advanced our productivity as a nation, but the reverse, for the higher wages paid in the United States have for generations drained Canada of its young people, and have diverted year after year the tide of European emigration to the country of our neighbors. Now whether the high wages paid in the United States were and are a result of protective tariffs there may be much debate, but high wages and protection have endured so long together in the United States that they are inseparable in the public mind. So ingrained is this sentiment that any proposal to reduce import tariffs on manufactured goods is regarded as a threat against wages and employment—and, apart from effect of specific action to reduce import tariff—the psychological effect on a working population is to induce alarm and a desire to leave a threatened territory. In some respects it may even be that this state of mind brings about the very effects that are dreaded, but, whether this be so or not, tariff charges are unsettling, and not lightly to be courted.

While the effect of high wages may be negatived by high living costs, there is nevertheless a decided satisfaction in the receipt of a high wage, for its usual accompaniment is a more luxurious standard of living. This is a feature that should not be overlooked by a country that is in the market for labor.

In Canada, at any time when protective tariffs have been at their highest, they never reached the point of effectiveness in raising living costs, and thereby necessitating high remuneration of labor, that the causes arising out of the war have done. If import tariffs have had any real effect on living costs and wages during the past few years, that effect has been in the direction of lowering prices by American importers in an attempt to offset the influence of the heavy discount on Canadian funds in New York. The discount on our dollar has been a much more potent deterrent to imports into Canada from the United States than any item on our tariff schedule. Similarly no import tariff of any outside country has been such a deterrent to Canadian exports as the existing discount of all other currencies in favor of Canada—with the sole exception of the United States. There is no doubt about the demand for Canadian goods, but the drawback is the price that we ask for exported goods. Are we to lower our import tariffs with the expectation that by reason of consequent lowered living costs we shall be able to compete in European markets?

Such a course might be suggested, were it not that the economic weight of the United States would find no barrier against it in Canada, and—except in those few instances where a superior combination of location and materials in Canada dictated an opposite course, manufacturing in North America would concentrate around the great central coalfield of the United States.

The policy of protective tariffs in Canada has been adopted to help out our national deficiencies. As a nation Canadians have been the victims of hypnotism arising from constant iteration of the vastness of our

natural resources, but, compared with the country of the United States, Canada presents vast extents which are chiefly remarkable for the paucity of their natural resources. Canada's problem consists in the intensification of the utilisation of domestic resources of inferior grade and difficult location, in competition with resources of the United States which are ideally located and of excellent grade, and the chief compulsion to adopt protective tariffs in Canada comes from the necessity to offset the economic deficiencies under which we labor in the attempt to perpetuate and consolidate our political independence in North America.

To be quite frank about this matter, is it not fairly evident that Canada can only avoid political absorption by the United States by achieving economic independence? There is no question of annexation sentiment, emanating from one side or the other, implied in this statement. It is a statement of the inexorable trend of economic conditions, which always gives political power to those nations that possess (or utilise, which is an equivalent thing) essential raw materials.

Our problem, therefore, is to maintain high wages in Canada, a high standard of living, and that extent of tariff protection that shall put us in the best bargaining position, and shall best avail to protect Canadian nationality and Canadian political independence. If tariffs should cause high living costs and high wages is that—for Canada—essentially an evil thing?

Group Insurance of Industrial Employees

In taking out a group insurance of its employees, day-worker and staff official being treated alike, the Port Arthur Shipbuilding Company has done a wise thing. Some method of indicating to an employee that he is a valued member of the organization is needed in every corporate industry, and it so often happens that the family of the salaried man is relatively worse off in the case of the unexpected death of the breadwinner than is the case with the day-paid worker. Group insurance, which is based on the mass-average liability, and does not necessitate individual medical examination as a preliminary to insurance, is really the old idea of the friendly society, but has the advantage over the friendly society of being actuarially sound, and of permitting the premium to be borne by the employer.

The gift of a group-insurance policy to each employee of an industrial concern—the only qualification for which is a minimum period of continuous service—is not mere philanthropy. It is good business. Any executive of experience knows to what extent it is often incumbent upon corporations to assist the relatives of employees who have died, and, while it is every man's duty to insure his life for the benefit of his dependents, it is sometimes not possible; and for one reason or another, good or bad, it is not always done.

Group insurance provides a bond between employer and employee. It helps a man in his home, relieves him of anxiety, makes him a more efficient worker; and, to the careful man, brings a welcome addition to his insurance estate that is doubtless fully appreciated as he has probably had occasion to learn how much individual insurance costs.

Utilization of Lean Canadian Iron-ores

The attention of our readers is called to Captain H. E. Knobel's paper on the use of Canadian iron-ores in Canadian blast furnaces read at the Winnipeg Meeting of the Canadian Institute of Mining and Metallurgy. A perusal of this paper will disclose Captain Knobel's courage in not attempting to gloss over the difficulties which have so militated against the use of iron-ores of Canadian origin as to reduce its consumption in domestic furnaces to a beggarly four percent of the ore annually charged thereto. But for the magnificent, and largely unappreciated attempt which the Algoma Steel Company is making to use domestic ore, even this pitiful percentage would disappear. The other side of the story is an annual importation of iron-ore, and iron and steel into Canada of $200,000,000 in value.

Captain Knobel makes two constructive suggestions, (a) the granting of a bounty on iron-ore mined in Canada, sufficient to offset the cost of beneficiation; and, (b), an experimental unit to test the possibility of the concentration and beneficiation of lean Canadian ores.

In regard to the suggestion of a bounty on iron-ore, such a procedure should commend itself to both the Federal and the Provincial Governments, nor will it involve any outlay of public money unless it is fully earned.

The provision of a testing unit has obvious desirabilities. The work which is being done at Babbitt, Minnesota, will probably yield some results that will be of guidance to Canadian investigators, but the Babbitt enterprise is a private one, on which much money has been spent, and, while secrecy in the arts is not nowadays much commended, it is but natural that economic determinations will be guarded by the Babbitt enterprise. In any case, however, this country should not hesitate to experiment and prove its own iron resources, and would not, if our leaders realised the significance of that humiliating four percent previously mentioned.

Captain Knobel mentions what is probably the greatest difficulty in utilizing Ontario ores, namely the absence of carbon fuel, but he suggests the coal deficiency may be minimised by a combination process of reduction of the iron-ore to a metallic state by coal heat and refinement to steel in the electric furnace. What appears to be a practical process along these lines has been perfected by Mr. J. W. Moffatt of Toronto, and was described in our issue of October (page 271).

The Government of Ontario might profitably investigate Mr. Moffatt's process, in the light of the statements made by Captain Knobel, and previously set out by resolution of the Ontario Mining Association. Investigation might well disclose the fact that while the lack of coal will be a deterrent to large scale production of pig-iron and steel from Ontario ores, there are ores in Ontario of such composition as would lend themselves to the manufacture of the finest alloy steels, if utilised by such a process as that which Mr. Moffatt has devised.

There is a great deal of preliminary investigation, of research expenditures, of spade-work, that must be done in connection with Canadian iron-ores before private enterprise will become very keenly interested in their utilisation, and this is work that properly appertains to a government that desires to see its mineral areas opened up.

When large sums of money are spent in the Lake Superior Region itself in investigating beneficiation of lean iron-ores on a big scale, it is surely more than a hint that the day of our own lean ores is coming, and if Canada does not desire to go to the United States for **lean ores** when the rich ores become scarce, then it is time we at least found out what can be done to concentrate our own ores for blast-furnace or other form of reduction. Captain Knobel's suggestions are sane and practical.

Brunner Mond Gift to Scientific Research Sustained

Messrs. Brunner Mond & Co., with the approval of a majority of its shareholders some months ago, voted a gift of £100,000 towards scientific education and research. A minority of the shareholders opposed this gift, and applied for a judicial injunction restraining the action of the Board of Directors. Mr. Justice Eve has dismissed the application, wherein lies matter for congratulation that, to quote the London "Financial Times", "a minority insignificant in number " and sadly lacking in commercial foresight,...will " not be able to hamper the action of a Board which " is breaking down that tradition of hostility to " scientific research and investigation which has done " more than anything else to retard our manufacturing " progress in recent years."

Mr. Justice Eve's opinion, in dismissing the application, was that the benefit which the Company would derive from its donation "was not too general, but " was likely to lead to the direct advantage of the " Company, and was conducive and incidental to the " firm's advantage as a chemical manufacturer."

Canada has an interest in the Brunner Mond gift, as this Company has large interests and active manufacturing operations in the Dominion.

"Canada Maintains First Place"

The Cleveland "Iron Trade Review's" survey of United States export steel trade contains matter for much reflection on the part of Canadian steel producers. Some quotations may be worth while:

"Among the usual purchasers of structural shapes, " Canada maintains first place, with 11,905 tons " shipped there in September, and 94,345 tons in the " full nine months."

"Canada took first rank as the destination of the " largest individual tonnage of plates in September, " its 17,877 tons outranking the United Kingdom's " shipment of 14,157 tons. For the mine months Can- " ada comes second to Japan with 151,750 tons of " plates.

"Italy, having maintained first place until Sept- " ember as an importer of pig iron produced in the " United States, now gives way to Canada. In the " nine months Italy took 33,412 tons and Canada " 35,433 tons.

A list of imports of steel products and pig-iron into Canada from the United States during the nine months of 1919 and 1920, ending September, is hereunder compared :

	1919 Tons	1920 Tons
Pig-Iron	29,552	35,433
Blooms, Billets and Ingots..	9,253	6,045
Steel Plates	144,899	151,750
Structural Shapes	9,158	16,739
Black Sheets	82,392	94,345
Tin Plates	26,016	52,137
Barbed Wire	18,576	16,320

It is in accordance with the traditional politeness of the dealer towards his customer to accord him "first

place" and high ranking as a purchaser, but Canada aspires not to be a customer, but a competing dealer. There are mills in Canada that are seeking an outlet for their product of steel-plates, structural shapes, rails and barbed wire, and during the past nine months no blast-furnace plant, no steel mill, no rail mill, no barbed-wire mill, and no blooming-mill in Canada has worked to absolute capacity.

The Strike of Railwaymen at the Steel Plants in Nova Scotia

The precipitate strike of the railway employees of the steel companies in Nova Scotia raises the question of the extent to which the authority of the executive officers of international labor unions should apply to the operations of a steel plant. The workers in a steel plant number tradesmen of almost every craft, but each craft group is small in numbers, and represents but a small percentage of the total employees. For example, at the Sydney Steel Works, the precipitate defection of 130 men has thrown between 3,000 and 4,000 men out of work, and has endangered the safety of the plant equipment in a manner that has no precedent in the steel industry in this country. If the officials of a steel plant in Canada are to be asked to obey the rulings of international union-officials purporting to represent the dozens of separate crafts employed in a steel-plant, their time would be much better employed in fishing than in attempting to direct industrial activities under such confusing, contradictory and arbitrary circumstances. In practice it cannot be done, and that is why the United States Steel Corporation has always dealt with its employees as steel-workers, and not as incoherent units attached to a thousand and one divergent interests and having unreconcileable aims.

The claim of the railway employees of the steel companies to be recognised as railwaymen is pointed out by the Minister of Labor—who cannot be regarded as unfavorable to the spread of international unionism in Canada—to be untenable, but it is particularly unfortunate that men of any craft should prefer to emphasise their adherence to a craft far above their status as employees of a steel company. As the General Manager of the Dominion Steel Company has pointed out, the hours and wages which apply to a passenger and freight-carrying road are not applicable to the continuous process of steel-making, nor is there any method by which a steel company can recoup itself except from profitable operation of its plant. Employees of a steel company—no matter what their special qualification—who will not accept the limitations of the industry would be well advised to find other employment, because the steel industry can only exist within its limitations, which, in Canada, are narrow and permit of no widening.

To stop the transportation of coal and coke, and other necessary materials in a going steel-plant, at seven hours notice, comes nearer to sabotage than any incident yet recorded in the history of the steel industry in Canada. One blast-furnace has been threatened with bursting due to the inconsiderate action of the railwaymen, adopted at the instance of an international union official. Instances of this kind in connection with any labor union have been rare in Canada, but such action by representatives of the railroad brotherhoods is entirely out of line with their usual policy.

OBITUARY.

James Percy Macnaughten.

James Percy Macnaughten, General Sales Agent of the Dominion Iron & Steel Company, died at his residence, after a long illness, on the 21st November.

Mr. Macnaughten entered the service of the Dominion Iron & Steel Company in 1903, succeeding to the position of General Sales Agent after Mr. Frank P. Jones became General Manager of the Company. During the earlier stages of the Company's progress Mr. Macnaughten resided in Sydney, but in recent years he had his office at headquarters in Montreal and resided in the City. He was born and educated in Ottawa, and was 53 years old at the time of his death. He was interred at Brockville, Ont.

Those who knew Mr. Macnaughten personally are best able to appreciate his loss to his family, the steel industry in Canada, and to the Company whom he has faithfully served virtually since its products were first placed on the market. He was a man who did not seek publicity, but whose integrity and loyalty could always be relied upon, as could also his assistance of a friend in need.

His early death, following that of Mr. Francis H. Whitton of the Steel Company of Canada, measurably thins the ranks of the steel men of Canada, never too numerous, and is a distinct loss to that industry, but a much greater loss to his immediate associates in Montreal, in Sydney and elsewhere.

R. B. Coulson.

Mr. R. B. Coulson, who had been in the service of the Dominion Iron & Steel Company as salesman for many years, died suddenly from an apoplectic seizure on a tramcar in Montreal upon his return from Brockville, Ont., where he had gone to accompany the body of his late chief, Mr. J. P. Macnaughten, for interment. He was interred at Guelph, Ont.

Mr. Coulson had many friends in the steel trade in Eastern Canada, and among the employees of the Dominion Iron & Steel Company, and his death, associated as it was with that of Mr. Macnaughten, evoked much sympathetic comment.

The Steel Trade and the Tariff Enquiry

By THE EDITOR

The last issue contained a review of the proceedings before the Cabinet Committee on the Tariff up to the completion of the taking of evidence in Nova Scotia.

In Montreal, on November 17th, the view of labor unions was presented by Mr. John T. Foster, President of the Montreal Trades & Labor Council, who said that organised labor in Canada was strongly in favor of moderate protection, or a protection sufficient to ensure the continuance of industries which are now the source of employment for Canadian workmen.

Mr. Foster advocated the appointment of a scientific advisory committee and a permanent tariff board, which arrangement he suggested might take the tariff out of politics, and avoid the unsettlement of business on the occasion of every election into which the tariff question was interjected. He did not hold that the tariff could be taken out of politics altogether, but a permanent tariff board, assisted by a scientific advisory commission, would help to attain that much-to-be-desired end. Mr. Foster's standpoint was supported by Mr. David Giroux, who represented the Canadian National Union, and who straightforwardly favored reasonable protection in the interests of labor in particular.

Mr. Foster stated, in a well-considered brief, that under the present system "each election caused con-"traction of business, unemployment and individual "debt, making each election an industrial tragedy". Mr. Giroux made the illuminating statement that "every trade union man is a protectionist".

Mr. J. T. McCall, of Drummond, McCall & Co., Montreal, said his firm had invested much money in the iron and steel trade, and had aided the business in many ways, when necessary financing the consumer in his purchases. As to the tariff, he said it had been built up on the policy of adequate protection, and he thought it would be disastrous to change that system. The Canadian tariff should be devised to encourage the mining of Canadian ore, a "scientific" tariff being hard to devise.

As to the present tariff he suggested that it be simplified by eliminating the numerous exceptions and changing the many different rates to as uniform a rate as possible. During the past ten years the centre of the iron and steel industry had changed from England to Pittsburgh, and he thought that some change should be made in the preference to increase importations from England to Canada, both for sentimental and economic reasons.

As to the present tariff, Mr. McCall said: "We submit that our business will be seriously interfered with unless the tariff on iron and steel articles, whether manufactured in Canada or not, is such as will not prevent their reasonable importation from abroad for the benefit of manufacturing consumers of this country."

There were inconsistencies in the present tariff, he said, and the commission should confer with prominent merchants who understood the entire business as well as the requirements of the Dominion, in order to arrive at a fair and reasonable rate of duty.

Mr. W. W. Butler, of the Canadian Car & Foundry Co., read a brief which included the views of the steel industry in the Montreal district as a whole. The memorandum set out the necessity for continued tariff protection for the industry. Last year steel and iron imports amounted to $180,000,000, or 18 per cent, of the total imports. The Canadian industry was hampered by having to import much of its raw material, in competition with a highly organized and well protected iron and steel industry in the United States. The heavy purchases in the United States also tended to keep up the high rate of exchange, while the home market was at best none too large.

Mr. Butler also complained that the American steel plants had their big protected markets, and in time of over production used Canada as a dumping ground, despite the anti-dumping law, which was not effective.

Mr. T. P. Howard, president of the Phoenix Iron Works, said that the output of his industry, a basic Canadian Industry, had decreased seriously since the end of the war. He agreed that it would be to the general advantage to have structural steel made in Canada. The industry had an investment of $26,000,000 which gave employment for many highly skilled and well paid men, but it had to compete with the far greater output and conditions of the American works, which were therefore in position to easily come into the Canadian market, unless it was protected.

The evidence before the Cabinet Committee at Hamilton was naturally chiefly concerned with the iron and steel industry of which Hamilton is the centre.

Mr. Robert Hobson, President of the Steel Company of Canada, submitted a carefully prepared memorandum, in prefacing which he stressed three points, namely, the need for adequate protection for the proper growth of this industry, the low rate of protection it got from the present tariff, and the probable disastrous effect the adoption of a policy of free trade would have on the Canadian steel industry in general.

A Basic Industry.

The Canadian steel industry being what he termed a basic or key industry, Mr. Hobson said that mostly all other manufacturers were dependent on it for their raw material. During the late war it was amply illustrated that the steel industry in Canada was a national necessity, otherwise the production of munitions on a large scale would not have been possible. Steel manufacturing in Canada did not really begin until 1900. Even now, Mr. Hobson said, there were single mills in the United States whose production was greater than the combined output of Canadian mills.

Overwhelming U. S. Competition.

Steel mills in the United States operated on such a tremendous scale that Canadian mills could not possibly compete with them unless there was a protective tariff, he added. Mr. Hobson cited many figures to prove the intensive methods of the steel mills across the border. The McKinley tariff, which became operative in 1890, had built up the steel industry of the United States, Mr. Hobson declared.

Referring to the low rate of protection at present afforded the Canadian steel industry under the tariff. Mr. Hobson gave figures to show the percentage of the tariff duty to the f.o.b. price in the United States. which averaged from 4 to 13 per cent. He contended these figures were too low to serve the purpose of prov-

iding necessary protection to Canadian industries. To prove this, Mr. Hobson said that the importation of steel from the United States since 1914 had increased tremendously. In 1914 this importation represented $80,063,679; in 1918 it had reached $169,538,669, and by 1920 had increased to $189,907,602. There were 65 articles manufactured of steel which were allowed to enter Canada free of duty. Some of these articles were finished products, while others were semi- finished.

"The result of a change in our fiscal policy, whereby the policy of protection would be relinquished in favor of one advocating free trade, would ruin the steel industry of Canada," Mr. Hobson declared.

European and British Competition Increasing.

With the prospect of Europe returning to normal conditions, Mr. Hobson thought the possibilities of export trade would undergo a great change. Before the war Germany had an export trade of five million tons of steel per annum. There was reason to believe that this trade would not be resumed by Germany, and when this happened the effect it would have, owing to abnormal rates of exchange, could easily be appreciated. German competition, under such conditions, would be a serious matter in future. The preferential trade with the United Kingdom should also be considered in this connection, Mr. Hobson said, He pointed out that the freight rates from Canada to the Motherland were about 19 cents per hundred pounds higher than were the rates from the United Kingdom to Canada. This, coupled with the policy of British preference, would give the British manufacturer a better opportunity to compete with Canadian mills than the former had ever had heretofore.

Free Trade Would Extinguish Canadian Steel Industry.

Mr. Hobson also emphasized the advantages mills in the United States would have in competing with Canadian mills on the Canadian market. Mr. Hobson concluded by urging a policy of greater protection. Free trade would prove ruinous.

The Steel Manufacturers' Case.

In conclusion Col. Hatch said: "On behalf of the iron and steel industries of Hamilton, we respectfully ask that in the coming revision of the Canadian customs tariff adequate protection will be afforded to insure future development of this basic industry, that is so essential to an all-round national growth."

Col. A. F. Hatch, General Manager of the Canada Steel Goods Company, Limited, who represented the manufacturers of iron and steel goods in Hamilton, said these industries in 1920 had imported material to the value of $9,534,756. Many manufacturers had located in Hamilton, especially United States concerns, by reason of the present protective tariff. If the Canadian tariff was reduced or abolished this would result in the selling field being restructed, output would be reduced, and cost of production would be greatly increased. On the other hand, if the tariff was maintained the industries for which he spoke would be fully developed, their costs would be reduced and the volume of their business would increase. Col. Hatch pointed to the encouragement that the Government of Australia had given manufacturers there. Ample protection was given there, chiefly to protect the home market.

Pittsburg Competition Keenest in Montreal.

Sir Henry Drayton, Chairman, asked Ross McMaster, Manager of the Montreal office of the Steel Company of Canada, where the most intensive points of marketing of this company's products were located. Mr. McMaster replied that these were Montreal, Toronto and Winnipeg, and all territory these centres served. Competition from mills at Pittsburg was most keenly felt at Montreal, while the influence of Chicago competition was felt at Winnipeg.

Future of Canadian Iron-Ore Mining.

Sir Henry wanted to know what the future development of Canadian ore mines was. Mr. Hobson replied that this was growing. As ore mines in the United States became more exhausted and the ore content of their product became less, Canadian ore mines would be developed on a broader scale.

U. S. Tariff Compels Canadian Protection.

C. W. Sherman, President of the Dominion Foundries & Steel, Limited, said the tariff should be applied in an equitable and fair manner, relative to values and starting with the highest duty on the finished article, and gradually decreasing to the natural resources from which these articles are produced.

"The Canadian tariff has many inequalities, and is in need of equitable revision," Mr. Sherman said. "The United States has recently voted a high tariff policy. A high tariff there and a low policy here would ruin Canadian industry."

A. F. Enlow, President and General Manager of the Dominion Sheet Metal Corporation, desired no change in existing schedules, and General Manager of the Dominion Sheet Metal Corporation, favored no change. The duty on galvanized sheets at present was 12½ cents. Black sheets for galvanizing were free of duty, and had been since his company succeeded in having this done by an Order-in-Council in 1917. He knew that certain interests wanted the duty lifted on galvanized sheets, but, speaking for himself, he favored no change. During the first two years his company operated, 1915 and 1916, it made no profit. Since black sheets were duty free the company, which was capitalized at $400,000, had paid back profits into the concern of $75,000, declared dividends of 8 per cent, and had no watered stock.

Protection Asked on Cold-Rolled Steel.

Protection for cold rolled steel was urged by Col. A. F. Hatch, in appearing for the Stanley Steel Co. He stated that hot rolled steel sold in the United States for $14 less than in Canada. Cold rolled steel, made in Canada, was sold in the United States for the same price as it was sold in Canada. Col. Hatch felt, therefore, that there was a direct discrimination against the Canadian market of this industry of about 28 per cent.

Mr. George H. Douglas, whe represented the Hamilton Branch of the Canadian Manufacturers Association, gave the following comparison of the economic status of Hamilton in 1905 and at the present time:

	1905	1920
Population	57,561	107,832
Industries	237	685
Capital invested	$28,232,829	$142,336,442
Workmen	12,663	30,944
Wages and Salaries	$6,126,346	$31,901,388
Value of Products	$24,625,776	$188,456,598

Mr. Douglas stated his belief that the three things that had chiefly contributed to the growth of Hamilton are: the measure of protection afforded by the Canadian customs tariff, which has caused the investment of capital and the development of industry, including branches of United States industries; the development and transmission of electric power, and the

specialization of farmers on the Niagara Peninsula, of which Hamilton is the largest centre.

The Tariff Has Brought Industries.

Mr. Douglas held that Hamilton illustrated in a striking way how the Canadian customs tariff had caused branches of United States industries to locate in Canada. But for the tariff those firms would have supplied the Canadian trade from parent institutions in the United States. The imposition of duties on their goods forced them to establish plants in Canada if they wished to maintain their markets. Protection had forced Hamilton to grow as a port. Imports in 1905 were valued at $9,391,454, the duty collected was $1,270,311. In 1920 total imports were valued at $41,-903,064, duty collected $6,114,470.

Very simlar figures were adduced before the Cabinet Committee at St. John, Sherbrooke and other Quebec centres of industrialism, where it was contended that the protection given by the tariff had brought prosperity, and was believed that withdrawal of protection would bring destitution.

The Mining of Iron Ore of Canada.

Mention was omitted in the review of the Tariff Enquiry in our November issue of the representations made by the Algoma Steel Corporation, and by the Board of Trade of Port Arthur, asking for a continuance of the tariff protection on steel and government assistance in the revival of iron-ore mining in Canada, at this time—with the sole exception of the ore being taken from the Magpie Mine of the Algoma Company—entirely defunct.

A labor representative who appeared before the Commission at Sault Ste. Marie, Mr. J. J. Brothers, stated almost the whole case for tariff protection in Canada when he said: "Industries which, by reason of their lack of natural resources, are unable to compete with those of countries which have an abundance of such natural resources, must continue to be protected by the tariff. Particularly was this true of the steel industry in Canada."

Mr. Brothers is to be congratulated on this lucid statement, which sets forth accurately the position of the steel industry in this country, and not the steel industry only.

The poverty of Canadian natural resources, relative to those of the United States, is the compelling reason for a protective tariff in Canada. Objection may be taken to use of the word "poverty," but consider the following comparisons:

For the Year 1919.

	In Canada Tons	In U. S. Tons
Iron Ore Mined	195,970	60,000,000
Coal Mined	13,586,300	535,000,000
Coke made	1,160,470	44,821,000
Pig-iron made	917,346	34,300,000

Compare also the following balance-sheet of mineral production and consumption:

Value of Imports into Canada in 1919.

Iron & Steel Products	$189,907,602
Petroleum	29,519,196
Coal	61,160,799
	$280,587,597
Value of the Mineral Production of Canada in 1919	173,000,000
Deficit	$107,587,597

Is there any other term but "poverty" that could be accurately applied to a country whose entire mineral production cannot pay its steel and fuel bills by the sum of one hundred million dollars?

SURVEY OF IRON-ORE DEPOSITS NORTH-WESTERN ONTARIO PROPOSED BY MINISTER OF MINES.

By J. J. O'CONNOR.

Members of the Port Arthur and Fort William Boards of Trade, had a conference with the Hon. Harry Mills, Minister of Mines, in the Mayor's office Fort William, on Nov. 27th. The subject under discussion was the advisability of the Province granting a bounty on the mining and marketing of iron ore, without restriction.

The Hon. Mr. Mills stated that as a Minister of the Crown he would not advise against the granting of a bounty, but as an individual giving his personal opinion, he did not think the granting of a bounty would result in a solution of the iron ore problem of this Province, that something more was required, more preparation for the securing of additional knowledge of the various ranges, as to quantity, grade and variety of the ores, and the various forms of treatment to which they would be amenable. He made certain suggestions that he thought could be worked out to advantage. These suggestions amounted to a complete survey of the whole situation regarding the iron ranges of Northern Ontario, and the best methods to be adopted for their development and use in the furnaces of the Province.

The Hon. Minister's suggestion to have such a survey made is a good one. Aside from the question of a bounty or no bounty, it is clearly in the interests of Ontario to have the fullest and most complete knowledge of its iron-ore resources, and there is no more direct or efficient manner of arriving at that knowledge, than by such survey by competent men.

This policy has been advocated by mining engineers who are familiar with the iron ranges, and their requirements.

Captain H. E. Knobel, who has had a wide and intimate association with the iron ranges of Northern Ontario, estimates that such a survey could be made by a party of five live men, under a competent directing head, in one summer season. He, and many others, are strongly of the opinion that when such survey is undertaken, it should be in the hands of, and under the direction of, experienced iron-ore operators, men who have had actual commercial experience in the beneficiation of iron ores, such as may be found on the iron ranges of Minnesota, where beneficiation has been carried to the highest efficiency yet attained. No survey of this kind would be of value, unless it were carried out by men with the capacity and experience to enable them to forge the necessary link between the technical and commercial end of the iron-ore problem. Either our iron ores are of value, or they are of no value. If they have value, that value is immediate and present. If of no value, the suggested survey would demonstrate that feature, and end the matter. If, on the other hand, it proves their value and availability for our own use, no time should be lost in their exploitation.

The Hon. Mr. Mills would be well advised to proceed at once with preparations for the survey under the right auspices, so that the work may be undertaken in the Spring of 1921.

Iron Ores of Commerce with Special Reference to Canadian Deposits

By SAMUEL GROVES, Ottawa.

(Continued from Page 300, November issue)

HEMATITE.

Hematite is an oxide (sesquioxide) of iron, known to chemists as *ferric oxide* (Fe_2O_3). It derives its name from the Greek noun *Haema*, signifying blood: on account of the fact that all varieties of the ore give a dull-red streak. In a pure state it contains 70 per cent has a hardness of 6, and specific gravity of 5.2 Like magnetite, hematite ores are widely distributed over the globe, in various forms: crystalline, massive, pulverulent, earthy, and reniform or kidney shape. And, while the colour of the ores is generally red, some of of the deposits are brown, others—such as the specular ores of Elba—are black, or steely-grey, which crystallize in the rhombohedral system, and have a brilliant, metallic lustre.

As already stated, hematite is in greater demand than magnetite, owing to its lower fusion point in the blast furnace, and general freedom from refractory impurities, such as sulphur, titanium, etc. It is fortunate therefore, that these non-magnetic iron ores are almost universally diffused, and are economically available to all the progressive nations.

Brazil.

The hematite depostis of Minas Geraes, near Rio de Janeiro, Brazil, are said to be the most extensive and richest iron ore beds in the world.

Within the Minas Geraes district alone—which is 100 miles long, 60 miles wide, and 5,400 feet above sea-level at the highest point—there are, it is conservatively computed, outcropping on the surface of the segregations, some 2,000,000,000 tons of hematite of remarkable purity, having a metallic iron content of 47—69.65 per cent, with very little sulphur, or phosphorus, and no titanium. The total available reserves are estimated at 12,000,000,000 tons.

The most favourably situated outcrop is the peak of Itabira do Campus, located about 1½ miles from the Central Railway, and towering 1,600 feet above it.

This deposit is 150 feet thick, and the rock face 500 feet high: composed practically, of the pure metallic mineral, having the following analysis:—

Iron	69.65
Phosphorus	0.0125
Silica	0.24
Combined water	0.38

When convenient transportation facilities are provided, the above mentioned, and other Brazilian deposits of like magnitude, such as the Canga, will become of international importance.

United States.

Next in magnitude to the Itabirite ores of Brazil, are those in the Lake Superior region, U. S. A., having an estimated reserve of 3,500,000,000 tons, mostly red hematite. In the Missabe range alone, the reserves are estimated at 1,600,000,000 tons. This iron ore deposit is 112 miles long, with the 50 per cent ore lying loose on the surface, like dust, and is mined cheaply; for it is simply scooped into great steel trucks, by means of huge 7-ton steam shovels, at the rate ,(in 1916) of 136,000 tons per day. The opening up, in 1890, of the immense Missabe iron ore deposits in the Lake Superior country—an event which has placed the United States in the fore-front of the nations, in iron and steel production—is of historic interest.

On the 19th of September, 1844, William A. Burt, a United States Government surveyor, while on duty in the Upper peninsula of the Lake Superior region, made a map note to the effect that he and his party had found in a certain spot, iron ore outcropping in abundance. With the exception of speaking of the discovery to some Indians they met, nothing more was said or done at the time. In the spring of 1845, however, P. M. Everett, of Jackson, Mich., while on a prospecting trip north, met, at Sault St. Marie, a half-breed named Louis Nolan, who related to him the surveyor's story of the existence of the iron ore deposits, and undertook to pilot the party to the spot. After travelling as far as Teal lake, Nolan was unable to locate the iron ore deposits. Everett—whose original objective was copper and silver—pressed on towards Copper Harbour, and on the way met an old Indian chief named Madjigijig, who also undertook to guide the party to the deposits, and straightway piloted them to the historic spot, since known as the Jackson mine. For services rendered, the officers of the Jackson Company gave the Indian chief a written certificate, of which the following is a copy:—

River du Mort, May 30, 1846.

This may certify that in consideration of the services rendered by Madjigijig, a Chippewa Indian, in hunting ores of location No. 593 of the Jackson Mining Co., that he is entitled to twelve, undivided, one-hundredths part of the interest of said mining company in said location No.

A. F. BERRY, Superintendent.
F. W. KIRTLAND, Secretary.

The agreement was never fulfilled, and Madjigijig died in poverty. This looks like another example of the world's ingratitude; but the fact is, that the original prospectors and lessees never made anything out of the enterprise. (1)

Most of the steel produced in the United States today, is manufactured from "Bessemer" pig-iron, made by the smelting of hematite ores having a minimum limit of 0.05 per cent of phosphorus. The great blast furnaces of Pittsburgh, Pa., and Gary, Indiana, U.S.A., get the major part of their "Bessemer" hematite ore supplies from Lake Superior region; while the southern manufacturers of the Birmingham, Ala., district procure their ores largely from the south end of the "Clinton" group of red hematite or fossil ore deposits, which take their rise in the State of New York, continue through central Pennsylvania and Tennessee, and terminate in northern Alabama; where the reserves are estimated at 355,000,000 tons, having an iron percentage of say 50 per cent at the outcrop in the Birming-

(1) The facts and illustration embodied in the above historic account, are taken, by permission, from Mr. Ralph D. Williams' book entitled "The Honorable Peter White: a biographical sketch of the Lake Superior iorn country," published by the Penton Publishing Co., Cleveland, Ohio, U.S.A., 1905.

ham district, but varying at depth to a hard calcareous ore, with an iron content as low as 32 per cent. All the southern fossil ores are "non-Bessemer"; but the phosphorus seldom exceeds 5.25 per cent.

Newfoundland (1)

Another hematite occurrence of great magnitude and economic value is found on the northwest shore of Bell Island, Conception Bay, Newfoundland: about 35 miles from the city of St. John's, and 425 miles from Sydney, Cape Breton, Nova Scotia. On the cliffs of Bell Island—which is 8 miles long, by 3 miles wide—six beds of iron ore are exposed: three of which are thin and of low grade, hence are of little commercial value, but the other three are of immense importance.

This iron-bearing area is unique, since it is almost entirely submarine—extending for miles under the Atlantic. Actual workings at a distance exceeding two from shore, indicate that the extensions under water are even greater in thickness and higher in grade than the deposits on the mainland.*

With the exception of the Itabirite mines of Brazil, and the Missabe mines of the Lake Superior region of America, the Wabana** mines of Newfoundland represent the greatest known iron-bearing area in the world. Mr. E. C. Eckel testified in 1913, before a legal tribunal in the suit for the dissolution of the United States Steel Corporation, that within a radius of 5 miles of Bell Island, there were 3,500,000,000 tons of economically available iron ore; that one of the series of contiguous deposits was 30 feet thick, containing 90 million tons per square mile; and that claims had been taken as far as 12 miles from shore.

Moreover, owing to the fact that the iron ore from "Wabana" mines is of higher grade than the generality of ores of sedimentary origin; and due to short local transportation distances to rail or tide-water; and to the comparative ease with which the ore is mined, it can be delivered in commercial quantities to Atlantic or European ports cheaper than any other competitive ore mined on the American continent.

The Wabana ores occur, as already stated, mainly in six contiguous beds or zones in the strata of the upper 1,000 feet of unmetamorphosed sandstones and shales, outcropping for about 3 miles along the northwest shore of Bell Island, and dipping under Conception Bay, at an angle of 8 degrees. The seried deposits are reported as consisting of two main iron-bearing minerals: one, having the reddish-brown colour characteristic of amorphous hematite; the other, greenish-grey and feebly magnetic—typical of chamosite; together with a quantity of siderite. The dominant ore, however, is hematite; showing, when freshly fractured, a reddish-grey colour, with sub-metallic lustre; and breaks easily into parallelopiped blocks, ranging from about 8″ to 1¼″ square.

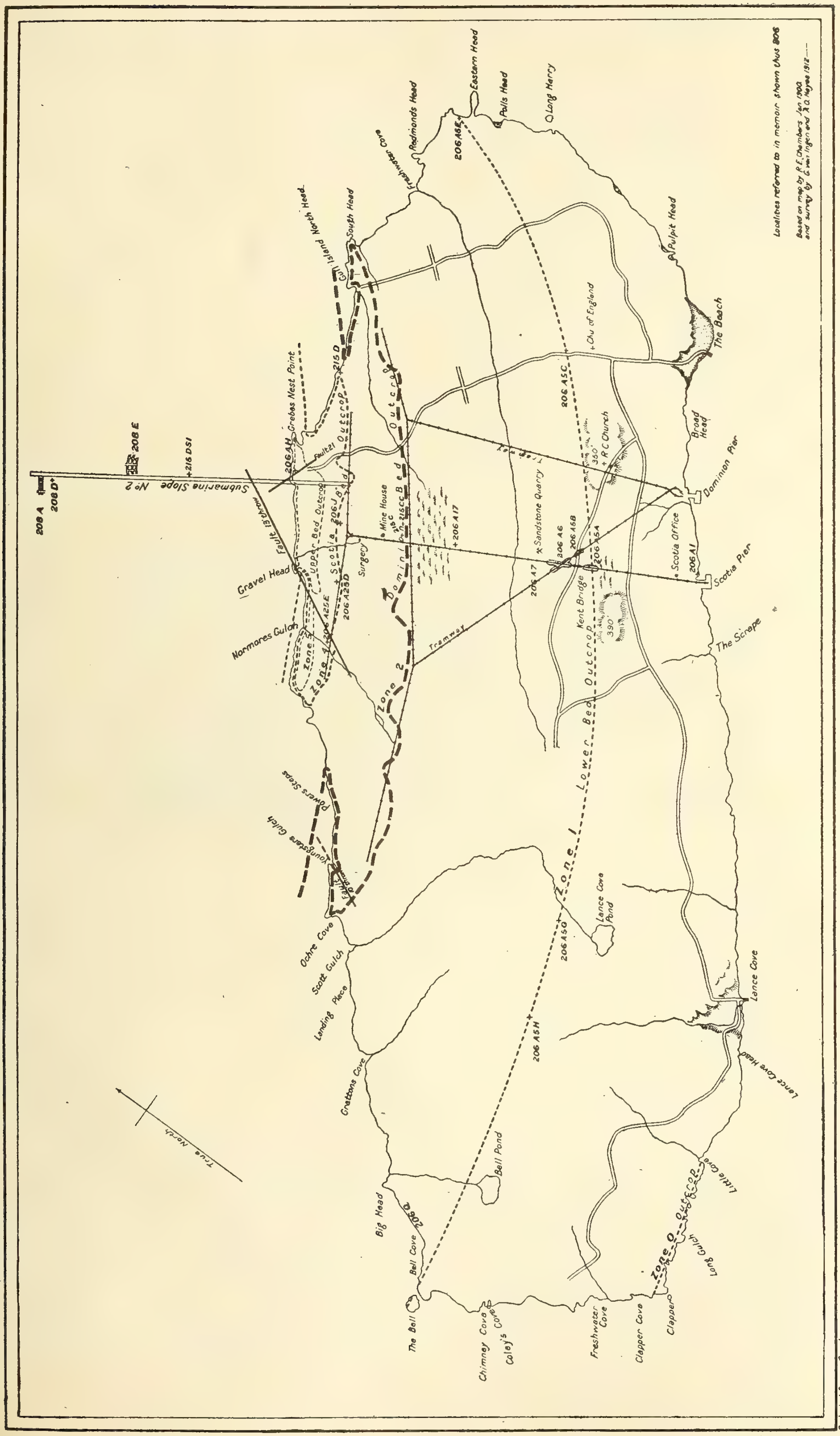
Jackson Mine. Spot where Iron Ore was first discovered in the Lake Superior Region, U.S.A.

At the present time, only three of the five beds of ore are being worked: known, respectively, as the "Dominion" or "Lower," the "Scotia," and the "Little Upper." The "Dominion bed"—which is owned by the Dominion Steel Corporation Limited, Sydney, Cape Breton, N.S.—is 243 feet below the "Scotia," and has an average thickness in the submarine area of 16 feet, with a known maximum thickness of 33 feet. The iron content of the ore ranges 50.50 to 53.0 per cent; with silica 10.5 to 14.0 per cent; and phosphorus 0.70 to 0.85 per cent. The "Scotia" bed—which is owned by the Nova Scotia Steel and Coal Company, Limited, New Glasgow, N.S.—is 50 feet below the "Little Upper" mine, with a thickness ranging from 7 to 9 feet, having an iron content of 53 to 56 per cent; silica 7 to 9 per cent; phosphorus 0.80 to 0.90 per cent. The "Little Upper" bed—controlled by the "Scotia" owners also—is the nearest to the surface of the three zones of "Wabana" ores on Bell Island now being operated. The land deposit covers about 70 acres, having an average thickness of about 6 feet. The iron content varies from

(1) The particlars used in describing the Wabana mines were obtained chiefly from the Report on the Resources and Production of Iron Ores of the United Kingdom and British Dominions, issued by the Department of Scientific and Industrial Research, London, England, 1917; and the Supplement to Part I, "Iron Ore Occurrences in Canada," Mines Branch, Department of Mines, Ottawa, 1917.

*"Wabana" means, in the Indian tongue, "the place where daylight first appears"; and was the name given to the iron ores of Newfoundland, by Mr. Thomas Cantley, in 1895.

**See issue of March, 1920, "The Sinking of the Wabana No. 3 Slopes of the Nova Scotia Steel and Coal Co., Bell Island, Newfoundland. R. E. Chambers."



Map of Bell Island, Newfoundland, showing the outcroppings of the ore beds.

56 per cent in the higher levels, to 51 per cent in the lower section of the bed; silica ranging from 6 to 10 per cent.

It was not until 1903, that the economic value of the Wabana iron ores was first recognized. At that time, the deposits were owned exclusively by the Nova Scotia Steel and Coal Company, Limited, New Glasgow, N.S. In 1899, however, the "Dominion" or "Lower" deposit, was acquired by the Dominion Steel Corporation Limited, Sydney, Cape Breton, N.S. Both these companies have worked the mines energetically: the last-named having produced from their mine, up to 1913, for utilization in their blast furnaces at Sydney, 4,375,-150 gross tons of the iron ores, for steel making purposes; while the former, between 1909-1915, shipped from their "Scotia" and "Little Upper" mines to the blast furnaces at New Glasgow, 4,806,277 gross tons. The aggregate shipment from the whole of the Wabana mines, up to the close of 1915, amounted to over 13,000,-000 gross tons. Shipments of iron ore from Wabana have averaged since 1915 from 500,000 to 900,000 tons annually.

The Wabana iron ores are all of "non-Bessemer" grade: since they contain more than 0.50 per cent phosphorus, the standardization limit for steel-making. The following is a typical analysis (Cantley, 1911) of ores taken from the "Scotia" bed:—

	%
Iron	53.86
Silica	9.48
Sulphur	0.018
Phosphorus	0.850
Alumina	3.55
Lime	1.81
Magnesia	0.84
Manganese	0.65
Loss on ignition	4.32

The output capacity per day from the "Dominion" mine is about 5,000 tons, and the "Scotia" mine some 2,500 tons. From the mines, the ore is transported to storage bins in the cliffs on shore, having a capacity of 25,000 and 40,000 to 70,000 tons, respectively; from which the ore, after crushing, is loaded into ships at the rate of more than 2,000 tons per hour. Steamships of 13,000 tons capacity can be moored alongside the wharves, from whence they sail to and from Sydney, New Glasgow, and European ports, all the year round, with the exception of a few weeks in mid-winter.

Coast of Bell Island, Newfoundland, showing Ore Beds. Dominion Bed, "a"; Scotia Bed, "c"; Upper Bed, "d."

Cuba.

Another country which, like Brazil, has recently come into prominence on account of it great iron ore resources, is Cuba. It is conservatively computed that the available reserves of payable ore amount to some 3,000,000,000 tons of high-grade hematite: 90 per cent of which is situated near the northern cost of Oriente Province. The extensive ore blankets have been delimited and defined into thre so-called iron districts: Mayari, the Levisa and the Moa fields.

The deposits vary in thickness from one ft. up to 60 feet. One bed was 100 feet before reaching the underlying serpentine. The average iron content is said to range (when dried at 212 deg. F.) from 40 to 50 per cent, with 2.6 per cent silica, phosphorus below Bessemer limit, and sulphur negligible.

Mining of these ores began, practically, in 1884: when 25,295 tons were produced. Since the Spanish-American war of 1898, however, and the consequent interest taken in Cuba by its powerful northern protector, remarkable progress has been made in the development ment of the Cuban iron ore deposits. In 1918, 634,442 gross tons of hematite—with some magnetite, were shipped to the United States alone—for the greater part of the known areas are controlled by five large United States industrial corporations—the destination being, Maryland, 598,070 ton; and the balance to Philadelphia, Canada got an additional 115,354 tons.

A characteristic feature of the Cuban ores is, the high percentage of water they carry: the hygroscopic water content being, generally, about 25 per cent. Provision has been made, on the spot, for eliminating this objectionable amount of water, prior to shipment. And a special feature of the Mayari nodule ores is, their naturally alloyed content of chromium and nickel. The fortuitous concourse of these valuable strength-giving alloys has been advantageously utilized by American metallurgists; for the celebrated "Mayari steel" is made exclusively from ores mined in the Mayari district. Tests of this steel as used in the Memphis bridge, indicated an elastic limit of 59,000 pounds, and a tensile strength of 94,500 pounds per sq. in. Being made from a natural alloy content of iron and chromium and nickel, the inevitable segregation of steels alloyed by the addition of nickel or other constituents, artificially added to the metallic bath, is avoided. This superiority is particularly manifest, when Mayari steel is subjected to heat treatment; for by

simply quenching in oil, track bolts evince a tensile strength of 100,000 pounds.

The Cuban iron ore fields* are destined to become an important factor in the development of the metallurgical industries in the cities on the Atlantic coast; for the ore beds are mostly on the surface, are soft and friable, hence like the Missabe deposits, afford excellent opportunity for machine mining on a colossal scale. The growing merchant marine of both the United States and Canada, will go a long way towards solving the transportation problem. It was stated during the progress of the U. S. Government's suit against the U. S. Steel Corporation seeking its dissolution, that Cuban iron ores were delivered on the Atlantic seaboard for about $2.50 per ton.

China.

For many years, China has been looked upon as having the promise of being one of the great iron producing countries of the world. This view has been largely due to the superficial observations, and consequent misjudgment, of the German traveller von Richthofen: who, in 1877, inferred from the large number of primitive iron ore smelting furnaces he beheld, operated by means of excellent coal procured in the vicinity—especially in the Chih-li district —that there must, necessarily be an abundance of iron ore nearby.

Recent investigation, however, by competent British, American, Japanese and Chinese mining engineers, has completely discounted the hitherto optimistic notions that have prevailed as to China's metallic mineral resources—particularly as regards iron ore. Authoritative reports like those of the British Board of Trade, 1905; and the International Geological Congress, 1910, are interesting, but not encouraging reading; while the verdict of specialist investigators like Mr. W. H. Shockley, of the Pekin Syndicate, and especially the evidence set forth by Mr. H. Foster Bain, in 1918,* goes to show that, the reserves of payable iron ores do not amount to more than say 400,000,000 tons; a figure which relegates China to a position of mediocrity among iron producing countries.

Comparatively little progress is being made in the development of even the ore deposits that are available, owing to the determined policy of the Chinese government to establish its right to the minerals under the land. No foreign syndicate or person is permitted to own a single iron ore deposit; those being exploited are leased only. Among the lessees, Japan ranks first; for owing to her island territorial limitations, and perpetual struggle to avoid congestion of her rapidly increased population, the "Sunrise Kingdom" has been fast changing from an agricultural to an industrial nation; hence the eagerness to control the idle iron ore fields of China—particularly the reputedly rich magnetite and hematite deposits of Manchuria—just as America controls the iron ore deposits of Cuba. In both cases, the realization of these commercial aims, is making for progress, and opening up to civilization, regions that were, heretofore, a veritable wilderness,; Japan has, for years past, been importing high grade ore from the Tayeh (Houpe) district, to the amount of over 50,000 tons annually.

In recent discussions on the prospective mining of iron ores in the Province of British Columbia, Canada, and the proposed utilization of the pig-iron smelted from these ores, in the iron and steel industries to be established, the fears that have been expressed with regard to the possibility of competition from Chinese iron ores or from pig-iron manufactured by cheap labour, may be looked upon as doubtful. Japan can, and will, utilize the available surplus, while in awakened China, under an orderly government, that country will need all its limited iron ore resources for home consumption.

Russia.

Reference has already been made (p. 8) to the magnetite deposits of the Ural, and their prospective exploitation as a valuable Russian export asset, when that unfortunate country achieves political stability. A like augmentation of foreign trade in the near future is probable with regard to the rich hematite deposits of southern Russia: notably the iron ores of the Krivoi Rog basin, some 100 miles northeast of Odessa on the Black Sea. These ores—which occur as lenticular, archaean inclusions, in some cases 120 feet thick—range in metallic iron content, from 55 to 70 per cent: the higher grade containing 0.7 to 0.9 per cent SiO_2, with sulphur practically nil, and phosphorus only 0.013—0.020 per cent. In 1912, 5,250,000 long tons were mined, being 67 per cent of the country's output. The total reserves were estimated conservatively, in 1910, at 86,000,000 tons, with 62 per cent of iron. And another promising Russian iron ore field is found in the Kertch peninsula, on the eastern side of the Crimea. These extensive hematite deposits contain from 40 to 45 per cent of iron, are of easy access, and close to the northern shore of the Black Sea.

These valuable iron-bearing deposits of Southern Russia, were known to the ancient Greeks, and were the probable source of the celebrated Scythian iron.

Canada.

It was pointed out, when dealing with magnetite, that the dominant iron ore occurrences of Canada are magnetic; due to the fact that the geological formation of the country is largely Archaeozoic. There are, however, several hematite deposits of importance in various parts of the country; but in almost every instance the minerals are mostly of sedimentary origin, and hence have undergone metamorphic changes. The most notable deposit of this character is the Helen mine, in the Algoma district of Ontario. This mine is situated 11 miles from Michipicoten harbour, on Lake Superior; and has produced more iron ore than any other mine in the Dominion. The shipments between 1900 to 1915 amounting to 2,263,522 gross tons.

The hilly range in which the Helen mine is located is 1¾ miles long, and for a distance of three-fourths of a mile averages 1,200 feet in width. The formation consists, mainly, of cherty and granular silica, intermixed with deposits of pyrites in commercial quantities. On the west side the ore bed is bounded by a clayey dike, which seems to have been the barrier against which the ore-body was deposited.

The ore is classified as "Old range" Bessemer hematite, and is easily reducible in the blast furnace, owing to its porosity. The iron content of the merchantable portion of the deposit ranges front 53 to 55 per cent, with sulphur varying from 0.20 to 0.40 per cent, phosphorus 0.095 to 0.092 per cent, and silica 6.16 to 5.90 per cent.

---

*The author is indebted for most of the data on Cuba, to C. M. Weld, E. F. Burchard, and British Board of Trade reports.

*Bulletin of the American Institute of Mining Engineers, September 1918, p. 1487.

In addition to the iron ore shipped from this mine, a considerable trade is done in the sale of the "iron pyrites" which occurs as pocketed masses of pyritic sand embedded in the lower levels of the iron deposit.

Between 1905 and 1915, some 37,372 gross tons of "iron pyrites" were shipped, but during the war period the demand increased owing to inability to import Spanish and other pyrites. Shipments in 1918, from the Canadian mines, were 411,616 tons , of which 268,-507 tons came from Ontario. Shipments in 1919 dropped to one half those of 1918. This mineral is largely transformed into sulphur-dioxide gas, for utilization in the making of sulphite pulp for the manufacture of paper; as well as for conversion into other compounds of sulphur used in the chemical and allied industries.

The decreasing yearly production of iron ore from the Helen mine is due to the fact that the portion of the ore-body wihch is of commercial value has been almost completely worked over, and the available reserve is reported to be probably less than 200,000 tons.

Other hematite deposits in the vicinity of the Helen mine are said to be of Bessemer grade—notably the Josephine mine, situated about 20 miles from Michipicoten harbour, on Lake Superior—but none of these are being developed at the present time. It is significant, that not a ton of iron ore was shipped from the Helen mine in 1919.

(To be continued).

LABOR TROUBLES AT THE NOVA SCOTIA STEEL PLANTS.

The railway men employed in the plant of the Dominion Iron & Steel Company, at Sydney, and on the colliery and plant branches of the Nova Scotia Steel & Coal Co. at Sydney Mines, acting under instructions from international officers of the railway brotherhoods, on the 22nd November, gave the two companies seven hours notice of their intention to stop work unless the railwaymen's wages were brought up to the standard railway rates for eastern Canada, under the application of the McAdoo schedule. The railwaymen employed in direct connection with the steel plant in operations have never been ceded the status of main-line operatives which they demand. A part of the railwaymen's demands includes a basic eight-hour day.

The number of railwaymen at Sydney is not greater than 150, but their precipitate action has thrown not less than 2,000 men out of work at Sydney, and the remainder of the 4,000 employees of the Plant are being employed, under difficulties, in operations such as the work of the Nail Mill, in which transportation plays a minor part.

By the short notice given by the railwaymen much of the equipment of the plant, particularly that connected with continuous processes, such as the blast-furnaces, open-hearths and coke-ovens, were greatly endangered, and great property loss has only been avoided by the work of the officials and volunteers, who have managed to keep a few locomotives moving. At the end of the first week of the strike—27th Nov.—the Company stated officially that No. 4 blast furnace, which was hastily closed down as a result of the seven hour ultimatum previously mentioned, was causing anxiety, it being feared that expansion, due to the large amount of limestones left in the furnace, which it was impossible to flux in the short time available, might result in the bursting of the crucible and its shell. The hearth of the furnace has since been raked out.

Following the stoppage of work by the railwaymen, the following note was issued by the General Manager, Mr. E. P. Merrill setting out the Company's difficult position.

"The public should know that there is an economic situation controlling the number of hours of work and the wages paid at the steel works at the present time. The plant was not designed not is it equipped to operate on the basis of an eight-hour day at cost that permits of reaching markets open to us.

"Our strongest competition is from the United States, where steel companies, prior to the war, accumulated large surpluses not subject to abnormal taxation, and which enabled them to install every known improvement and labor-saving device which made for lower costs and increased output. We have certain natural advantages in our geographical location, but we must have co-operation of employees and stockholders while we are building up our plant and our markets.

"For several months, in a declining market, we have sought business in all parts of the world, even offering rails in exchange for certain grades of ore and finished products to foreign governments on credits. Nothing has been left undone in an effort to keep all departments in operation, for we appreciate the need for employment and we know the value of maintaining our organization intact.

"The sooner the employees of the Dominion Steel and Dominion Coal Companies come to a realization of the honesty of our purpose to establish a permanent all-the-year-around industry in Cape-Breton, the sooner they will participate in the benefits.

"It must be evident to the most unthinking that we will never approximate or establish such a condition as long as our men blindly follow advices of outsiders as to how our business shall be managed.

"The McAdoo schedule and the Chicago award may be all right when they can be passed along in increased passenger fares and freight rates, but we are in no such position.

"We looked upon our men as loyal employees and good citizens and it is disappointing to us that by their action they left us without means to protect our property."

As it was well known that the Dominion Iron & Company was finding difficulty in marketing its products, some of the departments, such as the rail-mill, having been idle for some time, and other departments not working to capacity, the action of the railwaymen was not expected, and is not regarded by the other employees as being justified either by the wages of the railwaymen, or the results likely to be obtained.

The railwaymen take the ground that the dispute should be adjudicated by the Adjustment Board which deals with railway disputes, but the Department of Labor does not consider the men are being railway employees, inasmuch as the railway concerned "is not used for the ordinary purposes of railway work, taking passengers and carrying freight for the public". The Department therefore advises application for a Conciliation Board, but this the men will not agree to, expressing the opinion, in a published statement, that a Board of Conciliation could not dispose of the matter,

"its findings not being binding on either party to the dispute".

The Nova Scotia Steel & Coal Co. having previously closed down its blast-furnace and open-hearths at Sydney Mines, and prepared to operate the New Glasgow plant on cold stock until the trade conditions improved, has not been materially affected by the strike, and has so far managed to take away the coal produced by the collieries.

The collieries of the Dominion Steel Corporation are unlikely to be affected. The employees of the Sydney & Louisburg Railway, which is a subsidiary of the Corporation, have received the standard increases given to railwaymen in the Eastern District, and have also recently been granted the latest increase under what is known as the Chicago Award.

The enforced closing down of the coke ovens at the Sydney Plant, and the cessation of steel production, has stopped the operations of the Dominion Tar & Chemical Co., and will affect the Cross Fertilizer Company, which depends on slag for grinding.

At the time of writing (December 8th) the strike of the railwaymen was still continuing. The Dominion Steel Company takes the ground that it refuses to recognize the existence of a strike, regarding the railwaymen as no longer employees of the Company. Operations are being carried on as usual in such departments as this is possible, and indications are that steel production may not be resumed for an indefinite period. The blast furnaces, open-hearths and coke-ovens of both the Dominion and Scotia companies are closed down.

COMPANY NOTES

CROSS FERTILIZER CO., TO ERECT PLANT AT WELLAND.

The Cross Fertilizer Company has for some years been making from 40,000 to 50,000 tons annually of slag fertilizer by grinding the basic slag from the furnaces of the Dominion Iron & Steel Co., at Sydney, but it is announced by Sir Wm. Cross, during a recent visit to Toronto, that his Company proposes to erect a chemical fertilizer factory at Welland because of the inability of his company to obtain the necessary amount of slag. The nature of the fertilizer or the raw materials from which it is proposed to be manufactured is not stated otherwise than that the process will be entirely a chemical one.

STEEL COMPANY OF CANADA MAKING BENZOL.

The Benzol Plant of the Steel Company of Canada is stated to be making benzol in large quantities, much of this by-product being used for motor fuel. The market for benzol as a motor fuel, for admixture with gasolene and other volatile combustion oils, if properly cultivated, is without limit in view of the declining yield and the increasing consumption of natural mineral oils.

ALGOMA MILLS RESUME OPERATIONS.

Word from Sault Ste. Marie is to the effect that after a period of two weeks the trouble at the plant of the Algoma Steel Corporation has been settled. On December 1st the twelve-inch mill again started operations as did the eighteen-inch mill, the men having accepted the company's terms of three men to a crew instead of four as in the past. About two hundred men took part in the "walk-out" two weeks ago.

SAFETY EXHIBIT, DOMINION IRON & STEEL CO.

"National Safety News", the organ of the National Safety Council, contains a note and a photograph of an exhibit of the Dominion Iron & Steel Company at the Cape Breton Island Exhibition held at the end of September in Sydney, which was designed to emphasise both industrial and public safety. The idea of putting forward the community side of organised precaution against needless accident is a happy one, and local exhibitions afford a method of bringing the efforts of industrial companies in this regard to the attention of the families of the workers. The note to "National Safety News" was contributed by Mr. J. N. Worgan, the Safety Engineer of the Dominion Iron & Steel Company.

ARMSTRONG, WHITWORTH & CO., TO MANUFACTURE WOOD-PULP MACHINERY AT LONGUEUIL, QUE.

Armstrong, Whitworth & Co., of Longueuil, Montreal, announce that the parent company in England has taken up the manufacture of wood-pulping plant, both by chemical and manufacturing processes, using the designs of Jensen & Dahl, a Norwegian firm of much experience in this line of machinery. The Company proposes to manufacture barking-drums, pumps, grinders, wet-machines, mixers, screens, refiners, filters, hydraulic presses, etc., together with the electrical machinery for the drive. It is the Company's intention, eventually, to build machinery of this class at the Longueuil Works.

Incorporations.

MONTREAL.—The Forged Steel Specialties Co., Limited, has been incorporated to manufacture marine, foundry and mining supplies, with a capital stock of $500,000, by Arnold Wainwright, F. W. Hackett and Joseph J. Harold.

The Canadian Piston Ring Co., Limited, has been incorporated to manufacture pistons, etc., with $75,000 capital, by Ernest Lafontaine, Humbert Mariotti, R. Papineau-Couture and others.

The Rotary Brick Machine Co., of Canada, Limited, has been incorporated with a capital stock of $100,000 by W. Majewski, H. Sitarski and others.

TORONTO.—The Hold-Mar Vacuum Piston, Ltd, has been incorporated to manufacture iron and steel products, with a capital stock of $100,000, by Charles H. Yochum, 107 Gilmour avenue, Ernest M. Brooks, and others.

Canada Heaters, Limited, have been incorporated to manufacture stoves, furnaces, boilers, hot water heaters, etc., with $100,000 capital, by Robert E. L. Lott, 371 Roxton Road; Leo J. Pheland, 72 Queen street west and others.

The Plummer Machine Co., Limited, has been incorporated to manufacture and deal in iron, steel, brass and other metals, machinery, tools, implements, etc., with $100,000 capital stock, by Alfred R. Plummer, Arthur S. Dickson, Edward J. Swift and others.

The Canadian Superheater Co. has been incorporated with a capital stock of $200,000, by Norman J. Holden, Arthur Allan and others.

The All-British Signal Co., Limited, has been incorporated to manufacture machinery, signals, etc., with £80,000 capital stock, by Alfred P. Poussette, George Fuller, both of Holborn, England, Joseph Maurice, Chiswick Park, England, and others.

See & Smith Motors, Limited, have been incorporated to manufacture engines, motors, machinery, automobiles, trucks, accessories, etc., with $260,000 capital, by James S. Beatty, John R. Rumball, and others.

The Canadian Mine Shovel Co., Limited, has recently been incorporated to manufacture tunnelling machines, mechanical shovels, loading machines, etc., with $100,000 capital stock. The office of the company is at 202 Lumsden building. Officers are: President, Samuel Hoar; vice-president, C. E. Hendricks, and secretary-treasurer, W. J. Schultze.

PETERBORO.—C. Walter Green Co. Limited is incorporated here to engage in business as iron and steel founders, etc., and to take over the Company of that name. Capital stock is $200,000.

Extensions.

TORONTO.—Plans have been prepared for factory buildings on a 5-acre site at the corner of Hanson street and Coxwell avenue here which will cost about $500,000. The main building, which will be 80 x 500 feet, will on completion be occupied by three manufacturing concerns as follows: Crouse-Hinds Co. of Canada; Harvey-Hubbell and the Hubbell-Mack Machine Screw Co.

WALKERVILLE.—The Canadian Twist Co. is proceeding rapidly with the equipment organization of its plant here.

WATFORD.—Work will be started immediately on the erection of an addition to the plant of the Andrews Wire Works of Canada, Limited, here. When completed the company will have an additional 7,000 feet of floor space.

HAMILTON.—The American Axle Co., capitalized at $6,000,000, has secured an interest in the Beaver Truck Co., here, and in future will supervise operations. Under the reorganization H. R. Williams, who organized the Beaver Truck Co., becomes president and general manager; E. W. Macavay, president American Axle Co., vice-president, and Capt. Harry Trenaman, treasurer. The directors include William Mulvaney, E. D. J. Stares, W. H. Dawson, P. C. Wolf and P. J. Schultz. Plans are under way to turn out 3,000 trucks during the next year and arrangements are also being made to place a new model on the market.

AN EXTRAORDINARY PROSPECTUS.

One of the worst prospectuses we have seen is that issued by the Vancouver Magnetite Iron and Steel Smelting Co., Ltd. On the front cover is shown a plate of the "first pig iron made in B. C." described as being "fused in an electric furnace and then reduced by the duplex process." This no doubt refers to the test under the Fleet process at the Burnaby powerhouse in 1919. This test was pronounced a failure, and the pig which it is claimed was produced is the result of treatment in a furnace at the Vancouver Engineering Works.

The prospectus goes on to say: "This up-to-date furnace practice conforms with the very latest advancements in any skilled iron and steel metallurgy, thereby making absolutely obsolete for this province all ideas of treatment in antiquated blast furnaces, which necessitates additions of inferior soft ores high in phosphorus." This is the veriest buncombe and could only have been written by a person absolutely ignorant of smelting iron ore. The Fleet process under which this company produced its sample of pig is an electro-metallurgical process. Pig iron or steel produced by electro-metallurgy is much more costly than the product of the Bessemer or open-hearth furnace; is produced for special purposes commanding higher price, and the nature of the process confines it to narrow limits. The electro-metallurgical furnace cannot possibly compete with the blast furnace. If it could the large British and American iron and steel firms would have substituted it long ago. No sane man would propose to supply an iron furnace with "inferior soft ores high in phosphorus" as alleged by the writer of the prospectus.

The prospectus then compares its molehill with a proposed capitalization of $100,000, with a mountain in the shape of the U. S. Steel Corporation and its capitalization of about $1,500,000,000 and corresponding profits; and says "Co-operation will make Vancouver another Pittsburg." Unfortunately we have not found tributary to Vancouver the iron ore deposits that made Pittsburg, or anything like them.

The directors of the company are: President, Dr. T. S. Hall, New Westminster; Col. F. C. McTavish; J. B. Hall, of Hall Machine Works; Capt. Robt. Bailey; A. L. Teetzel, of MacPherson and Teetzel, all of Vancouver; and A. E. Wright, C.E., of Trail; managing director, Percy H. Fraser, Vancouver.

Dr. Hall, the president, is an enterprising man, and we don't believe he would allow his name to be used in connection with this promotion if he had investigated its merits as set forth in this prospectus. The managing director, Mr. Fraser, is a dry goods man, who was actively connected with the promotion of Omineca Gold and Copper Queen mining companies, concerning which prospectuses were issued of a similarly questionable character to that to which we now refer. He knows nothing about the iron and steel industry, and how a highly technical business is to be successfully managed by a man who knows nothing about it is a problem which it is the duty of the directors to explain when they are asking the public to subscribe for shares to $100,000, to be increased to $200,000.

L. B. Philpot, electrical engineer, of the Philpot-MacDonald Company Ltd., was on the prospectus as Advisory Electrical Engineer, but his name was put there without his consent and to his credit he demanded its withdrawal and advertised the fact that he had no connection with it. If others would take the same creditable stand we should have fewer of these unsound promotions which are simply sink holes for the savings of the public who are too often misled by the names appearing in connection therewith. This must be stopped if public support is to be enlisted in the development of mining and metallurgical industries.—B. C. "Mining and Engineering Record."

SHIPBUILDING

STEEL SHIPBUILDING IN CANADA DECLINING.

In the November issue of this periodical it was noted that the outlook for steel shipbuilding in Canada was discouraging, and it was pointed out that the industry is in grave danger of entire disappearance while waiting for a declaration of the policy of the Government, because it is becoming evident that without definite state-aid, in one form or another, the steel shipbuilding industry is unlikely to survive the crisis through which it is now passing.

One of the strongest shipbuilding organizations in Canada, and the one having the most dependable affiliations with overseas shipbuilding connections of long experience, is Canadian-Vickers, Ltd., of Maisonneuve, Montreal Island. The remarks of the President of this Company, made at the launch of the "Canadian Commander, were given in the last issue at which time also the Minister of Marine admitted that his Government did not look upon its action to that rate as constituting a permanent solution of the problem.

A month later, on the occasion of the launching of the "Canadian Leader", the General Manager of the Company stated that already forty percent of the Canadian shipyards had sung their swan-song, and that, unless Government aid was forthcoming, the same prospect faced Canadian-Vickers. There were, Mr. Gilham said, no orders for next year on the firm's books, and after the launching of the two boats now on the stocks, which was anticipated to take place next April, the yard would have to close unless new orders were received.

In this connection it is pertinent to note the editorial remarks of the "Financier", London's oldest financial daily, which points out that the amount of shipbuilding under progress in the Old Country yards is shown to be increasing by each quarter's returns. On September 30th., vessels aggregating 3,731,000 tons gross were under construction in the United Kingdom, which, to quote the "Financier", "does not look like depression".

The General Manager of the Canadian-Vickers also has stated that there was little difference between costs of building and repairs in Canada and in the United Kingdom, but the unfavorable exchange rate was the chief deterrent to the obtaining of orders from the other side.

The steel shipbuilding industry in Canada is a logical, a proper, and a necessary one. It has already done great things. It is prepared to do greater, but, if it is not to languish and die at this juncture, it should be assisted over what is quite obviously only a temporary phase. Steel shipbuilding must, and will, thrive in Canada in the years that are to come, but, if it is allowed to pass out now, the period of that permanent revival that all who think over the history of nations must agree is coming, will be causelessly and indefinitely delayed.

There has never yet arisen a powerful mercantile marine in any civilised country that was not in its earlier stages fostered and assisted by the State.

If, after having founded a mercantile marine that is now engaged in advertising Canada's renown in all the seven seas, our leaders become faint-hearted, Canada will lose her place in the race, and will not gain the laurels that may otherwise be hers.

At the sessions of the League of Nations, it was considered necessary by the Canadian delegates to strongly oppose any restriction on the distribution of raw materials. This signifies that those who represent Canada in the counsels of the world understand her wealth to reside largely in raw materials. Is it not then proper and necessary that we should build and own the ships that are to carry these materials abroad?

When the St. Lawrence waterways provide a channel for sea-going vessels to Fort William, our Atlantic and Pacific seaboards, combined with this unprecedented penetration of a continental area by an arm of the sea and its feeders, will make Canada a maritime nation of the first rank, and will make her waterborne transportation to rise to magnitudes that will be a world's wonder. The extent and the variety of the craft that will be required cannot at this time be visualised, but it will have an indefinite capacity for expansion.

It is extremely improbable that a government that has shown such vision and such faith in Canada's maritime destiny as the present administration will not exert its full powers in support of steel shipbuilding in the country, but the tide of opportunity is rapidly ebbing.

Difficulties of Canadian Shipyards.

Following the inability of the Prince Rupert Drydock & Engineering Co. to proceed with construction of the two vessels being built to the order of the Canadian Government, owing to financial difficulties, there has been much disturbance among the employees of the Company, to whom wages are owing, and local suppliers of material who have accounts against the shipbuilding company. The completion of the government's contract was guaranteed by a bond of the London Guarantee & Accident Co., for ten per cent of the contract price, namely $321,000. The Guarantee Company has not replied to enquiries regarding its course of action, and at the time of writing, it is understood the Department of Marine is considering the best way out of the difficulty. In the meantime, it is understood, the Company has agreed to pay all claims of $100 and under in full, and one-third of all other claims at once. A third of the remainder will be paid when the ninth instalment on the ships is paid by the Government, and the remaining one-third will be paid on receipt of the tenth instalment. This should relieve the questions connected with payment of wages due.

The Guarantee Company has the option under its bond agreement to complete the work of building the vessels in the event of failure of the contractors, or making suitable arrangements for completion. The matter now lies between the Guarantee Company and the Department of Marine.

The completion of the vessels now partially constructed in the yard of the Dominion Shipbuilding Company, at Toronto, which it was announced would be undertaken by the Government, is being complicated by agitation in Toronto to have the work done by Toronto workmen, and opposition is expressed to a suggestion that the Collingwood Shipbuilding Co. might be given the work. A large number of workers in Toronto were displaced by the stoppage of work at the Dominion yard, and these men are naturally very anxious to obtain such employment as may be available in the completion of the partially constructed vessels.

Port Arthur Shipbuilding Company.

The last of the Government contracts for Canada's Merchant Marine, awarded to the Port Arthur Shipbuilding Company, Limited, the "Canadian Harvester" was launched November 20th. Mrs. F. H. Keefer, wife of F. H. Keefer, K.C., M.P., Port Arthur, named the ship.

This ship is full Welland Canal size, of the following dimensions and power:

Hull.	Engines and Boilers.
L. O. A.—260′6″.	Triple Ex. Engine 18″-30″-50″x36″.
L. B. P.—251′0″.	Boilers 2 Scotch 14″x10″9″.
Beam Molded.—40′6″.	Steam Pressure, 180 pounds.
Depth Molded.—26′0″.	Speed, 11 knots.

This ship is of the two deck type with poop, bridge and forecastle; Steel deck house on bridge, with Captain's quarters and pilot house, with power plant amidships, and is built on the transverse system under the highest class of British Corporation Ocean Service.

When completed, this ship will be the largest canal-size ocean freighter constructed by the Company, being especially designed to carry a large cargo, on account of the restricted dimensions necessary to enable her to pass through the St. Lawrence system of canals in one section.

The management entertained the launching party to a luncheon at the Prince Arthur Hotel, immediately following the launching. The manager, Mr. J. H. Smith, announced that they had recently laid the keel for a 3,000 ton canal-size vessel, which will be specially adapted to Lake and Ocean service, the ship is to be of all steel construction, with power plant located aft, and the Captain's and crews quarters and pilot house located forward on the forecastle deck.

The power plant will be equipped to burn either coal or oil, and special provision will be made for storing of the fuel oil in the water bottom, also ample capacity will be allowed for coal in the bunkers, located forward of, and at the sides of boiler room. With modern installation of oil burning equipment, it will be possible to change from coal to oil, or vice versa, within a few hours time.

The "Canadian Harvester" is rapidly nearing completion, and will get away before the close of the navigation.

Inasmuch as the demand for new tonnage is growing less, Mr. Smith announced that the Company had decided to go into the designing and manufacturing of pulp, and paper machinery. The plant acreage, buildings, and tool equipment being well adapted to be manufacturing and handling of the heavy equipment required in the pulp, and paper trade. The outlook for the future of the pulp and paper trade, is exceptionally bright at the Head of the Lakes. There is pulp wood, almost beyond computation, tributary to this point, by water and rail transportation. Two mills are in operation, two more are under construction, and others are seeking sites on which to erect large plants. It looks, therefore, that with unrestricted power, at reasonable rates, that this point is certain to become a paper centre at an early date, and the Port Arthur Shipbuilding Company is fortunate in being in a position to take advantage of the situation in furnishing the equipment necessary for this development.

With the idea of branching into the new industry on as large and extensive scale as possible, they have secured the services of a particularly capable Engineer, and expect soon to be turning out such equipment for the trade, as Digesters, Grinders, Chippers, Slashers, Barkers, Pumps, Screens, Wet Machines, and Board and Paper Machines.

The Company has just completed installing new boilers in the Canadian Government Survey steamer "Bayfield." The Dry Dock and repair department of the Company has been kept well employed during the season.

Vancouver Dry Dock.

J. Coughlan & Sons, who have obtained the contract from the Federal Government for the construction of a dry dock at Burrard Inlet, Vancouver Harbour, have commenced work on the site. Test-borings are practically completed, and the work of excavation is being proceeded with.

Nova Scotia Steel Co. Launch "Canadian Sapper."

The S. S. "Canadian Sapper" was launched at Trenton, Nova Scotia, on November 9th. Mrs. Geo. D. Macdougall, the wife of the General Superintendent of the N. S. Steel Co., performing the ceremony. The vessel is 2,800 tons, 285 ft. long, 38 ft. beam, draft 20′ 6″.

With the exception of a steel yacht on the stocks, no further orders are booked for this yard, and it is not probable that work will continue unless the Company should decide to build vessels to its own order.

Vickers Launch Canadian "Leader."

The twelfth vessel built for the Canadian Government by the Canadian-Vickers Yard, at Maisonneuve, and the sixth in the 1920 season, the Canadian "Leader," was launched on the 27th. Mrs. W. G. Ross, the wife of the President of the Harbor Commissioners, performing the ceremony.

At the reception which followed the launching Mr. Gilham, the Managing Director, said that the conditions which faced the steel shipbuilding industry in Canada were very gloomy.

No Orders for Next Year.

Over forty per cent. of Canadian yards had already had their swan song, and unless Government aid was forthcoming the same prospect confronted Vickers. "The sorry fact is, that we have no orders for next year. We have two boats now on the stocks which we expect to launch next April, and if there are no further orders by that time the yards will be forced to close." It was hoped, he continued, that the Government would realize the great importance of this young industry to Canada, which was capable of such expansion, and which, throughout Canada, had already furnished work for 50,000 men.

Mr. W. G. Ross, president of the Harbor Commissioners, said that the greatest launching that had ever taken place there was the launching of Vickers itself. When it was first suggested, people thought that the idea of competing with English firms was a dream, but the firm had been started and had achieved great things. Mr. Ross said that Vickers was of the greatest importance to the port of Montreal and the country generally, and hoped that the Government would come to the aid of the shipbuilding industry and make it possible for it to carry on. The present condition, he believed, was only temporary.

The Exchange Rate.

Mr. P. L. Miller, general manager of the company, also referred to the loss the country, city and harbor, would sustain if the industry was to go under. The costs of shipbuilding and repairs here, he said, were very little different to the costs in England, but the unfavorable exchange rate prevented Vickers from quoting a price that would induce British interests to send their money across.

The vessel is of similar dimensions to those previously built for the Government. Net tonnage is 3,340 tons. Cargo capacity is 8,350 tons.

Halifax Shipyards.

The yards at Halifax are quite busy, and between 1,400 and 1,500 men are now employed, according to the Halifax "Chronicle."

The "Canadian Forester" and the "Canadian Fisher" built at Three Rivers, by the Tidewater Company, are lying at the pier, having been sent down the river to be finished in Halifax. The "Canadian Explorer" the second of the two ships under construction by the Shipyards to the Government's order, is scheduled to be launched by Sir Robert Borden on the 18th December. The work on this vessel is far advanced. Two other hulls, Nos. 3 and 4 on the yard's program, are under construction.

Two steamers are in for dry-docking and repairs. The Halifax dry-dock is generally booked for some time ahead, and at this time of the year there is usually much repair work called for.

Port Arthur Shipbuilding Company Adopts Group-Insurance.

The Port Arthur Shipbuilding Co. has taken out a group-insurance policy for its employees amounting to approximately half a million dollars. Under the terms of the contract, each employee who has been with the company six months or more on June 30 is insured for an amount of $750, and for those who were not with the company for six months on June 30, the policy goes into force when they have put in six months' service. Additional insurance of $250 goes into effect six months after the first policy is issued, making a maximum of $1,000 for each individual.

One feature noticeable in this policy is that the ordinary workman is put on the same basis as the highest official of the company, as all receive the same amount of insurance.

Three deaths have occurred since the policy has been taken out on the lives of those covered by the insurance and the amount of the policies have been paid promptly and in each case the amount was found to be a big help to those dependent upon the policy holder. In one case tis cash saved the home, which had already been put up for sale by the mortgage. The first death occurred July 20, only twenty days after the insurance was applied for, and before the actual policy had been written.

The individual certificates are now being distributed to the employees covered. No doctor's examination is required, the only qualification necessary being six months' continuous service, and the insurance continues in force so long as the employee continues his employment with the Shipbuilding Company.

Shipping and Shipbuilding Outlook.

Only just recently some people were disposed to bewail the tribulations of the shipping trade, and were predicting a state of depression that was hardly distinguishable from disaster. For some months past predictions of this character have been made on the platform, in private and public meetings, and likewise in published statements. The pessimists have been energetically rebutted by the optimists, so that we have seen something like two powerful camps arrayed against each other. As a consequence, partly, of the preaching of the pessimists we have seen a sliding of prices in the Share Market. This preaching has not been the only influence operating on the market. There have been other powerful factors at work, and particularly the labour unrest and the strikes, which have made the average investor super-cautious.

But the dividend recently declared by the P. and O. Company has gone far to lessen fear and anxiety and to restore more vitality to the Share Market generally. Only a short while back P. and O. Deferred stock persistently fell, until the price was down to 360, and it looked like sinking to lower depths. This was because of the power of the pessimist, who declared that the company would be unable to keep up its dividend, with the unfortunate result that some nervous holders sold their stock. So far from the company being unable to maintain its dividend, it has actually increased it subtantially, and so put the pessimists to shame. The price of P. and O. Deferred immediately shot up about 60 points, and, though it has lost a part of this rise since then, the fall is due mainly to profit-taking, and not to any new feeling of anxiety or nervousness.

In the current monthly review of the London Joint City and Midland Bank, some encouraging statistics are given in regard to shipbuilding in this country.

While the total of the merchant shipping under construction in the world is declining, the figures for the United Kingdom continue to show expansion. This does not necessarily mean that our shipyards are more active than they were in 1919, because there is now no longer an abnormal amount of mercantile tonnage in the yards requiring repairs. During the current year it has been possible, therefor, to concentrate to a larger extent upon the construction of new tonnage.

At the end of September last 50 per cent. of the merchant shipping tonnage under construction in the world was being built in this country. Before the war the proportion was about 60 per cent., but at that time only a small amount of tonnage was built in the United States of America. What effect lower freights are having upon the amount of new tonnage being ordered in this country is not apparent from the returns. All that the figures show is that at present the work actually being undertaken is increasing each quarter, until on September 30 vessels aggregating 3,731,000 tons gross were under construction in the United Kingdom. About 440,000 tons gross of merchant shipping were completed in the September quarter of 1920, compared with 405,000 tons in the previous quarter, and 308,000 tons in the first quarter of the year. This, to say the least, does not look like depression.—"London Financier."

THE MOOTED STEEL INDUSTRY IN BRITISH COLUMBIA.

The British Columbia Gazette contains the incorporation notice of the Coast Range Steel Company, with capital of $15,000,000 authorized. The principal is Mr. Henry J. Landahl, with whom is associated F. T. Congdon, J. D. Kearns, John Steta, and Major Montague Moore. No information has been given out as to the location proposed for the mooted industry, but is believed the mainland is favored. British capital is stated to have been interested, and two engineers, Messrs. C. T. Williams and Francis Perry have been in British Columbia to investigate the local facilities and report to principals in London.

Another group of British interests have, it is understood, been looking into a similar project. Mr. Walter Dennis Rock, an English mining engineer and steel technician had been for some time making quiet enquiries, but was taken ill and died with tragic suddenness. Previous to his death, Mr. Rock had arranged for shipment to England of a test-lot of Pacific Coast coal, for determination of its coking qualities. It is stated that if the coal proved to be suitable for making metallurgical coke, Mr. Rock's recommendations to his principals would have been in favor of the establishment of a steel plant at some point within the Province.

It was also stated that the Canadian Collieries (Dunsmuir) Limited, previous to Mr. Fleming's resignation as President of that Company, was looking into the possibility of establishing a steel plant on Vancouver Island. Mr. Fleming is himself a practical steel metallurgist, having had much experience in the smelting of magnetites in New York State.

The incentive to establishment of a steel industry in British Columbia is the bonus of three dollars per ton on pig-iron produced in British Columbia from provincial ores that is offered by the British Columbia Government, and the knowledge that the establishment of iron and steel manufacture in the Province is favored by the local government, recently sustained in the elections.

Just how much of recent activity in regard to steel projects is a result of the political excitement is not discernible, but some part of it must be attributed to the elections.

Judging from eastern analogies, it would appear to disinterested observers that the proper place for a blast-furnace and open-hearth plant, with adjacent coke-ovens, utilizing the waste heat and coal-gases in the steel-making processes in the most approved method of modern steel-plant practice, is somewhere on Vancouver Island, where the necessary maritime location for assembly of raw materials, and for distribution; and the essential proximity of coking coal, are combined as in no other part of the Province.

The present time is not propitious for transfer of British funds to Canada, as with discounting and exchange almost 25 percent of the funds raised in Britain would be lost in transit. The erection of a modestly conceived blast-furnace and open-hearth plant in Vancouver Island, in association with existing coal companies there, and financed largely by local capital, would offer to British Columbia the most permanent and profitable form of steel industry in immediate prospect.

There are two phases of the steel industry in British Columbia, and it is desirable that the two should not be mixed in the public mind. The electric-furnace reduction of high-grade, but refractory, magnetites, such as is proposed by the Rothert Steel Company in Seattle, is one phase. This Company has now a plant with a daily capacity of two tons, and it is proposed, according to latest advices to enlarge this to fifty tons. The Rothert process is virtually the making of alloy steels, in which such elements as titanium are not undesirable, but it is essentially an industry limited in production, demanding high-grade raw materials, and suitably located only where electric power is cheap and available in large quantities.

The other phase is the orthodox blast furnace and open-hearth plant, making pig iron, on a large scale, and making steel-ingots as required. There is only one place in British Columbia for such an industry, and that is as near to coking-coal mines as possible, and on the sea-coast.

The is also the combination process—using fuel-heat and electric heat in successive stages—devised by Mr. J. W. Moffatt, of Toronto. In this process it is desirable that both fuel-heat and electric-heat should be cheaply available, and the coal mines and large water-powers of Vancouver Island in this instance afford the proper combination.

The least important matter in the steel industry in British Columbia is the location of a plant near the iron-ore deposits, as this is about equally difficult as regards all the B. C. iron-ore deposits. The important, and actually the decisive factor, is the provision of the heat to be used in smelting and refining the ore, and on this consideration the choice of the plant site should be determined, if commercial success is to be achieved. Fuel costs are, and will increasingly become, the chief preoccupation of the steel plant executive in all parts of the world. Proximity to a coking-coal deposit should be the guiding desideratum in the choice of a steel-plant site in British Columbia.

REPAIRING POURING LADLES BY THERMIT WELDING AT BRITISH-AMERICAN NICKEL SMELTER, NICKELTON, ONT.

Owing to the nature of the smelting process followed at the Nickelton, Ont., plant of the British American Nickel Corporation the slag obtained sometimes runs high in metal content, the action of which is very destructive to the steel pouring ladles, tending to wash away the steel at the point of contact and injure the ladle beyond further practical usefulness.

The company has recently been getting economical results in reclaiming its ladles by means of Thermit welding. The accompanying illustrations and sketches give an idea as to the work done. In both cases described pieces of steel were forged and welded to the ladle rather than completely filling up the burnt areas with Thermit steel. By this method undue contraction strains were minimized.

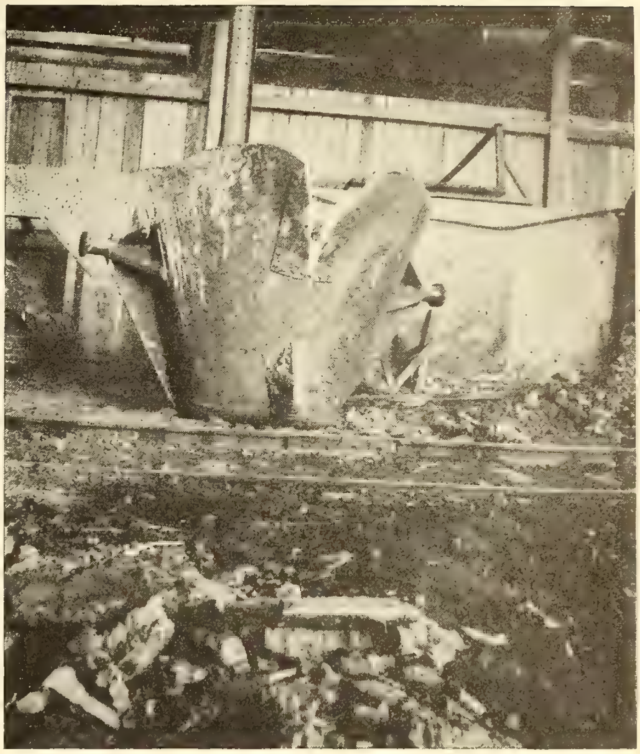
In the case of the ladle with the holes in the bottom three patches were made instead of two, as shown in figure 1, owing to the irregularity of the holes and the facility of making two patches easier than one irregular patch. In lining up the patches approximately 1 inch was provided at the edges for the entrance later of Thermit steel. These patches were surrounded by a yellow-wax pattern and the usual Thermit welding practice then followed.

Fig. 1.
Three patches in place before application of wax collar.

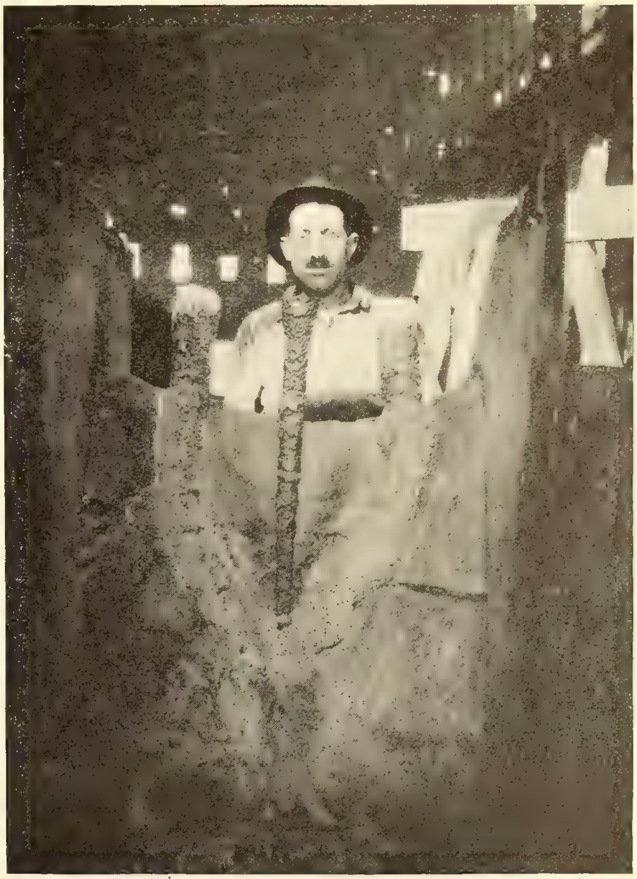
In arranging riser patterns these patterns were used both inside and outside, one coming off at the high point and two others placed about half way down on the wax. These latter two served to take care of the shrinkage of metal when the weld started to cool. The welding of the bottom was spread over two operations, owing to the fact that there was insufficient material on hand to complete the job the first time.

In the case of welds made on the sides of ladles care must be taken not to put too much stock in the collar of the weld, otherwise there would be a tendency to retard the clearing, or so-called "skulling" of the ladle. In applying the wax collar the wax should be from ⅛ in. to 3-16 in. fuller than finished shape in order to allow the shrinkage during contraction.

In forging the lip patch, the blacksmiths followed the outline of the cut material, cutting and shaping it to provide a space of about 1 in. It was no small job to shape the patch, and it is believed that in future repairs of this kind time can be saved by cutting away the ladle to a square shape as shown in one of the sketches. The lower portion will not then lend itself readily to melting down during the preheating operation. It may also be preferable to cast the lips of steel rather than forge them.



Ladle lip burnt away by hot matte.



Showing lip of ladle welded, before removing risers and pouring gate.

How to Record Graphically Work Done in Forging

By COLONEL DAVID CARNEGIE, F.R.S. Ed.
M. Inst. C.E., etc.

A most interesting paper was read by Mr. Eugène Schneider of Creusot at the Autumn Meeting of the Iron & Steel Institute at Cardiff, England on the subject of "An investigation of various forging operations carried out under hydraulic presses."

The recording apparatus used in the investigations was designed by the Forge Dept. of the Creusot works. The experiments remind me of several I conducted at Woolwich Arsenal soon after the first hydraulic shell forging plant was installed there. At that time I was in charge of the Department and being desirous of ascertaining the actual "work done" in the operations of punching the steel blanks and then drawing the "cups" into shells I designed a rather crude but simple device for obtaining pressure curves.

In a paper which I communicated to the Institution of Civil Engineers in January 1892, nearly 29 years ago, on the subject of forged steel projectiles, I gave diagrams of the "work done" in forging 4.7" shrapnel shells.

To obtain the work diagrams I made several experiments with an ordinary hydraulic pressure-gauge modified to carry a slide across its face in the place of the usual glass face. This was done by mounting two guide brackets on the body of the pressure-gauge after removing the ordinary glass face. The guide brackets were so arranged to allow for a slide to be moved horizontally to and fro across the face of the gauge. On the slide, which in my first experiments consisted of a sheet of thin glass, was fixed a sheet of smoked paper upon which the pressure curve was scribed by a fine pin fixed near to the end of the needle of the pressure gauge.

The slide was connected, by a cord, direct to the moving heads of the rams of the hydraulic press which carried the punches. The forging press was horizontal having two cylinders placed end to end and rigidly connected together. The pressure gauge, to which the slide was fitted, was fixed to the main pressure pipe near to the inlet in one of the cylinders. When the cord attached to the slide was connected with the moving head of the ram the slide was given exactly the same rate of movement.

A zero on datum line was made by the needle of the pressure gauge upon the smoked paper by moving the slide to and fro by hand over the face of the gauge before any pressure was applied. A second line was obtained, (somewhat more irregular than the first, the irregularity depending upon the speed of the press), when the cord was connected to the ram head and moved by it "running light" and before any actual forging was done. The pressure curves showing the actual work done were not quite so easily obtained. The circular movement of the needle of the pressure gauge which scribed the curve and the rectilinear motion of the slide caused by the movement of the head had to be allowed for and adjusted in reproducing the curves shown in the diagrams given in the paper to which I have referred and which are reproduced in fig. 8 of that paper and in fig. 1 of this note. The method devised by the Forge Department at Creusot for converting the circular motion of the pressure gauge needle into the rectilinear movement of the carriage containing the ink well for recording the curves eliminates the work of adjustment and reproduction which I had to do in obtaining the results.

Figs. 8.

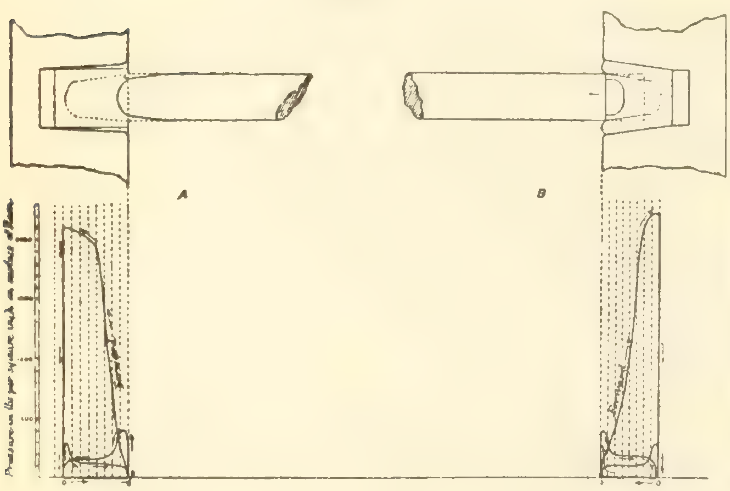
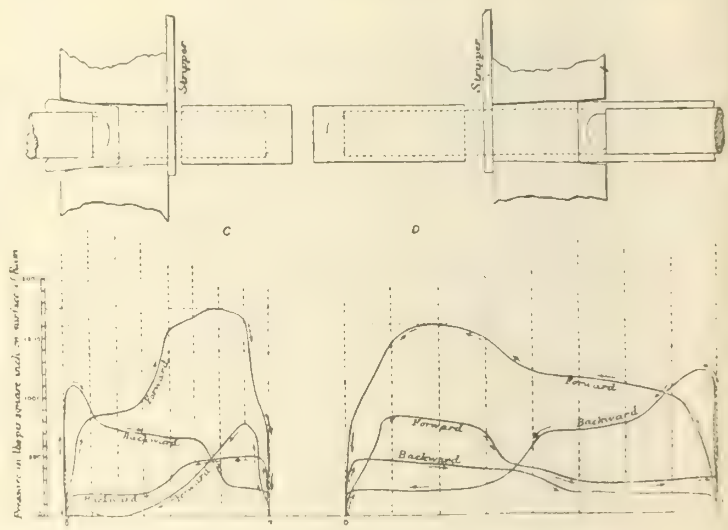


Fig. 1.



Diagrams Illustrating the Work Performed in the Process [illegible] 4·7 Inch Shrapnel Quick-Firing Shell

From the diagrams I obtained the following results:

1.—Work done during the first punching operation 65.9 foot tons.

2.—Work done during 2nd operation, forming inside cavity, 55.9 foot tons.

3.—Work done during drawing operation, 309.1 foot tons.

4.—Work done during final drawing operation, 404.6 foot tons.

These results were obtained during the forging of 4.7" shrapnel shells.

I found what Mr. Eugène Schneider found that the amount of work done or energy expended in producing shell forgings depended upon several well known facts.

1.—The temperature of the shell blanks during forging. (Uniformity and degree of temperature).

2.—Condition and form of punches and dies.

3.—The speed at which the work was done—that is the rate of movement of the press.

4.—The concentricity of the punches and dies.

5.—Other minor conditions known to forgemen.

I need not dwell upon the importance of being able to make and retain graphical records of work done on different types of forgings. This will be apparent to all manufacturers, who are using different kinds of machines for making different types of forgings. Whether in making stampings, or drawn materials of steel and other metals where ordinary pressure gauges are used for visial registration, the recording apparatus devised at Creusot such as shown in plate E of the paper referred to should be of very great service. It will also suggest to engineers and users of differend kinds of forging machinery other ways of obtaining the same results with perhaps less complicated apparatus.

THE INDIAN HEAD IRON ORE DEPOSIT.—PORT AU PORT, NEWFOUNDLAND.

By a Correspondent.

Newspapers have recently published more or less sensational and absurd reports of the discovery of an iron ore deposit at Port au Port, Newfoundland. These reports are absurd insofar as the price at which the claim is said to have changed hands, is fabulous, while the truth is that the ownership has not really changed hands at all; and sensational insofar as the stressed immensity of the deposit has not yet been proven.

The existence of iron in this locality has been known ever since a road was built through there about 25 years ago, or at least the Dominion Iron & Steel Company were first made aware of it at that time. Nobody seems to have become interested in its possibilities until 1913 when an American lady tourist summering at a resort nearby, brought a drill crew there. But rumor says that these men never used the drill as they apparently failed to locate the ore and anyway their efforts came to nothing.

Within the past few months the Dominion Steel Corporation have been investigating the property. They have had some prospectors at work during the past summer and latterly have had a mining camp built and a regular gang employed. During the summer too, some well known geologists have visited Indian Head in the corporation's interests, and have made very satisfactory reports. Indications encourage the belief that a very large body of workable ore is there, and there are millions of tons in sight along the outcrop alone. The outcrop runs across the main road from Stephenville Crossing to Port au Port, extending half a mile north and three quarters of a mile south of this road.

The rocks of the vicinity are of pre-Cambrian age and are generally metamorphosed, as are most of the rocks in the island, although in this case there is some evidence of sedimentary deposition. These rocks are said to be, in many respects, like the pre-Cambrian rocks of the Adirondacks, N.Y. In the northern prolongation of Indian Head, they consist of: granites, syenites, diorites, pyroxenites, anorthites, basalt, pegmatites and metalliferous bodies. The more acid members of the series, the granites and pegmatites, frequently exhibit their intrusive nature; while the more basic one shew no evidence of that and occupy banded areas. The typical textures, structures, and mineral composition of all the rocks are those of the normal kind although many of them are changed by metamorphism. Certain parallel structures along which the mineral is aligned could be accounted for on the supposition that after cooling, tremendous vertical and lateral pressure re-melted the rock to a viscous state during which there was a re-arrangement of the minerals. Many of the rocks for this reason are gneiss. Parallel with the sheeting and flow-gneiss are granites and syenites, and with these are associated bands and lenses of magnetite and hematite which may be granular or massive in structure. The heavier particles of metallic iron disseminated through the adjacent rocks would tend to separate out while the matrix was still molten and the bands and lenses may have been formed by magmatic segregation. Both magnetite and hematite is found and the deposit is not unlike the great iron-ore deposits of Norway and Sweden.

Indian Head, the Laurentian mass in which this potentially immense metallic body is found, is shaped like a wedge running nearly North and South, thirty miles in length and four miles in width, lying between two large areas of Carboniferous rock, with its southern extremity jutting out into the waters of St. Georges Bay.

The rocks shew evidence of movement after the close of the pre-Cambrian period, probably at the end of the Ordovician and again at the end of the Carboniferous. Since the mass was first formed and elevated, erosion has been going on, and the glaciers of Pleistocene times have helped to reduce what was once probably a conspicuous mountain peak, to more or less of a low tableland.

The out-crop opened up by the summer's work, shews for 2 miles an uninterrupted belt of magnetite and hematite varying in thickness from 3 to 9 feet. Occasional faults occur with a slight displacement of the ore-body to a higher or a lower level. This belt dips about N. 10 E., at an angle of about 33 degrees. How far the iron body extends beneath the overlying mountain is what the Dominion Steel Corporation is now endeavouring to ascertain, but it promises to compare with any great iron-ore body of like nature found in the world today. The quality of this ore is all that could be desired, giving a very high percentage of iron and being remarkably free from impurities. Its composition it said to be very like that of Swedish iron-ores.

The accessibility of this deposit adds much to its value. It is 5 miles from the main line of the Reid Newfoundland Company's railroad, and 12 miles in a direct line from Port au Port. A short railroad to this spacious harbour would present no difficulties in the building and would provide splendid shipping facilities, abundant cheap wharfage area with deep water close inshore, and the railroad would be down-grade for loaded trains, when there was a grade, as the mine is four or five hundred feet above sea-level.

Electric Furnaces, Power Plants, and Metallurgical Development in South America

The countries of South America possess vast resources for the development of hydro-electric power. In support of such a development efforts are being made to cheapen the cost of fuel for transportation and other purposes, coal being not only very high priced but also difficult to obtain, and to extend railways so that interior sections may be made accessible.

In Argentina, the Iguazu of the northeastern corner of the country and the great group of water power resources in northwestern Patagonia, Neuquen, Rio Negro, and Chubut are capable of producing enormous quantities of hydro-electric power. Due to their remote locations, they have attracted less attention than the limited resources of Cordoba, Tucuman, and Mendoza.

The falls of the Iguazu afford the best single resource in Argentina and one of the best in the world. Accordingly, the Argentine Government, under the Direccion General de Navegacion y Puertos, has inaugurated a survey preliminary to the construction of a power plant there. It is reported that an international power plant, with a capacity of 150,000 horse power, will be erected jointly by the Governments of Agentina, Uruguay, and Brazil. At present, La Compania Hidro-electrica de Tucuman (English) is the only power plant established in Argentina. La Empresa de Luz y Fuerza (German) has a concession for the construction of a power plant at Mendoza. Work on this plant was begun several years ago, but was indefinitely suspended because of a dispute over the concession. The Municipality of Mendoza is to construct a power station at the falls of the Rio Blanco and to build an extension tunnel and aqueduct system costing $5,600,000.

Dr. Julius Klein, the United States Commercial Attaché to the Argentine Republic, says that power plants could well be established near Salta in the northwest, near Iguazu, and in the Rio Negro district, to serve Bahia Blanca of the southeast, and that there will be a great demand for electric power for supplying the various railroads which contemplate the electrification of their lines. At the present time the Argentine railways use three-fourths of the coal consumed in Argentina.

Brazil has extensive plans for the development of interior transportation, including the construction of power plants for industries and the electrification of railways. The Director of Public Lands and Colonization, Department of Public Works, Porto Alegre, Rio Grande do Sul, called last August for bids for the erection of a power plant of 30,000 horse-power on the river Jacuhy. The concession is for 30 years at the expiration of which time the State will take over the installations. La Empresa Electrica de Jundiahy and the Sao Paulo Electric Company have ten-year contracts for furnishing 8,400,000 kilowatt hours of power for the Paulista railway, which is now being electrified. The Government owned line from Barra to Pirahy of the Central Railway of Brazil is also to be electrified. Rio de Janeiro is to have a 270,000 horse-power plant erected in the near future by an internationally organized company having American interests, according to Dr. Julius Klein, United States Commercial Attaché to Buenos Aires. Two hydro-electric stations are to be built and an electric Street car service inaugurated in the vicinity of Rio de Janeiro.

Itabira Iron Ore Co. to use Electric Smelting.

The Itabira Iron Ore Company, Limited, recently secured a concession from the Brazilian Government to construct and exploit high temperature furnaces, a steel factory, and reducing apparatus, etc., and plans to electrify the Victoria-Minas railway for which an electric power plant will doubtless be constructed. An electric smelting plant, the first of its kind in South America, will be built in Ribeiro Preto, Province of Sao Paulo, by the Companhia Electrica Metallurgica Brazileira. The construction of the mill will be started as soon as the American contractors can get their engineers on the ground. The mill will be 75 miles from the mines of iron ore in the Province of Minas Geraes.

Bolivia in its present stage of development is a country of mines, though other resources exist. There are only three or four towns of any importance and population, and the present field for street railroad and power transmission material is restricted. The greatest hydro-electric resources are those in the vicinity of La Paz, Tres Cruces, and Colquechaca and plans for their exploitation have been made. The three initial power plants will entail an expenditure of $10,000,000 and will require large quantities of other machinery and electrical accessories in addition.

The La Paz-Yungas electric railroad is now being constructed by the Bolivian Government with funds largely raised through a $2,400,000 loan made in the United States a few years ago. This line and the Corocoro copper mines, whose directors are considering the electrification of their plant and the City of La Paz itself, for lighting, heating, cooking, and industrial purposes, will utilize power supplied from the Yungas River near La Paz.

The progressive mining section of Tres Cruces requires power and heat and needs two tramways operated by electricity to connect Oruro and Cochabamba. The Cochabamba-Valparaiso Railroad needs capital to complete the electrification of its system and to reconstruct its lines to meter width.

The wealthy mining district of Colquochaca lacks electric power and heat, and an extension of the railway to Uncia, another mining center, is urgently needed.

An electric line known as Cochabamba, Vinto, Cliza tramway, controlled by local capital, at Cochabamba, has been completed for upwards of forty-five miles and an additional mileage to a total of fifty-seven miles is under construction.

Electric lighting plants exist in about a dozen towns and tramways in three or four.

The Bolivian and General Enterprise Company operates the tramways, electric lighting and telephone systems of La Paz, a city of 100,000 population, the capital of Bolivia. This company is owned almost entirely by the French munitions firm of Creusot and Schneider. The power is hydro-electric and the tramway line is approximately three miles in length, operated with eight cars of American make.

La Sociedad de Luz y Fuerza Electrica de Cochabamba, a local firm capitalized at $2,000,000, operates the previously mentioned interurban line terminating in Cochabamba and also furnishes light and power to the towns along the line,—Arami, Vinto, Puncta, Tarata, and Cliza. The hydro-electric station on the Chocaya River supplies the power.

Sucre the capital city sadly lacks modern transportation facilities. La Empresa de Luz y Fuerza Electrica de Sucre has a monopoly of the light and power supply of the city. La Empresa de Luz y Fuerza de Oruro, a hydro-electric development, has lighting and power privileges. It is local concern. A mule tramway still exists in this town of 23,000 persons.

Tarija and Potosi have hydro-electric light and power, the former from Erquis, six miles distant, and the latter from 32 servoirs built by the Spaniards in the 16th century on the hills above the city.

Hydro-electric power is beginning to be utilized by the tin and copper mines of Bolivia. The Guggenheims of New York have acquired rights to three tin mines in the Department of La Paz, consisting of more than 4,000 hectares. Water and power rights to some six streams in the vicinity of the mines have been secured and a hydro-electric power plant is to be built, but the site has not been decided on. The installation of a smelting plant run by electricity is under consideration. The company plans to found a town below the mines and construct an electric tramway to it.

The Bolivian Government has been for some time contemplating the electrification of all railways and has declared as public domain the waters of such rivers, as are capable of being used for the development of power. The Jafe de la Seccion de Ferrocarriles del Ministerio de Fomento has charge of these projects.

In Peru, most of the important cities and towns have electric light and power systems. Tramway systems traverse the streets of Lima, Callao, and towns adjacent thereto, and are also established at Arequipa. La Empresa de Telefonos Arequipa y Mollendo operate the local and long distance telephone system of Arequipa and surrounding district.

Las Empresas Electricas Asociadas de Lima (Lima Light, Power and Tramways Company) controlling electricity and gas franchises in and adjacent to Lima, as well as more than 86 miles of tramway, is the most important public utility company in Peru. The Peruvian Telephone Company (partly local and partly British capital) furnishes the telephone service for Lima, Callao, and nearby places.

La Sociedad Electrica de Arequipa, Ltd., a local company, furnishes electricity for light and power to Arequipa, the metropolis of Southern Peru and its environs. El Tranvia Electrico de Arequipa, Ltd., controls the traction service of that city; W. R. Grace and Company, as agents for the Bond-holders' Syndicate, operate the line.

Various sections of the Peruvian railways are being electrified as power for that purpose is provided,, especially the interurban lines near Lima. The last division of the Southern Railway of Peru (from Mollendo to Arequipa, Puno, Cuzco and from Gaqui, beyond Lake Titicaca, to La Paz, Bolivia) is an electric six-mile line.

The mines of Peru are beginning to appropriate the hydro-electric resources of the Peruvian Andes. The Cerro de Pasco Copper Corporation of Cerro de Pasco, Province of Junin, Peru, is now installing a large up-to-date smelter at Oroya and providing modern housing and other facilities for its workingmen, all of which will consume considerable electric power, which is likewise being provided.

A vanadium ore-reducing plant for the mines of Minasgra, Peru, is to be built at Jumasha, Peru, by the Vanadium Corporation of America, of Pittsburgh, Pennsylvania. A hydro-electric plant capable of furnishing 20,000 kilowatts power for treating the ore is to be constructed about 25 miles from Jumasha.

In Ecuador, public utility development has been very slow. In Quito, the capital, there is an electric tramway line installed by J. G. White and Company. This, together with the Quito Electric Lighting and Power Company, which furnishes light and power, is owned by the Ecuadorian Corporation, a British company. Guayaquil, the largest city and chief port, has two street car lines and electric lighting. The municipality of Portoviejo is to erect an electric light plant.

Chile has vast hydro-electric resources, which have been but slightly developed. German and British capital, chiefly, has been invested to provide public utilities in Chile.

The most definite development project in Chile at the present time is that provided by a $35,000,000 loan by the Chilean Government, $10,000,000 of which has been appropriated for the electrification of the railway from Santiago to Valparaiso, via Casablanca. The electric generating station is to be located on the Aconcagua River about 30 miles from Llai-Llai. In fact the Chilean Government will electrify all the State railways, and plans are in charge of Senores Rafael Edwards, the electrical consulting engineer for the State railways, and Ricardo Solar, a civil and electrical engineer of prominence.

Moreover, an internationally organized company (Anglo-Chilean-Americano) in Valparaiso plans to construct a 100,000 horse-power plant for supplying electric lighting and power to that region.

The Antogasta-La Paz Railway, a British-owned line and one of the largest in the nitrate region of northern Chile, is to electrify its lines at a cost of $7,800,-000, which project will entail the erection of a power plant.

Colombia with her abundant hydro-electric resources, about five electric light and power plants representing about one million dollars, and various electric and steam tramways, operated in the five chief cities, exhibits an attractive field for electric installations. Her cities are becoming modernized with the development of her industries and her mineral resources are being exploited as never before. A power company in Zipaquira is to construct a new plant near the Neusa River. Irrigation interests in Tolima will construct several large locks at La Bolsa near Espinal to facilitate the installation of an electric plant to provide lighting for El Espinal, Guamo, and El Chicoral.

A number of the larger Venezuelan cities and towns have electric lighting and tram service. The Caracas Electric Company utilizes the 111 feet rapids in the Guare River for the generation of power. The torrential Chama River near Morida is likewise useful. The Caroni Falls will be harnessed to provide the necessary hydro-electric power for the newly planned electric railway from San Felix on the Orinoco River to the Guasipati gold fields.

A BIG STEEL AND ENGINEERING TRADE PROBLEM.

Future Supply of Pig-Iron.

By E. T. GOOD.

British steel-makers and engineers must set about early and earnestly, no matter what the cost may be, to increase the number of modern blast-furnaces in this country, or the great additions made to our steel and engineering works capacity since 1914 will prove fruitless in the coming commercial competition. Pig-iron is the foundation of the steel and engineering trades. During the war, and subsequently up to the present, we have been able to produce more steel than pig-iron, owing to the abnormal quantities of scrap made available by the processes of munitions production. But this abnormal supply of scrap is coming to an end, and if we do not secure compensating quantities of pig-iron, a great proportion of our steel and engineering capacity must starve. Since 1914 our steel output capacity has been increased from a rate of about 8,000,000 tons a year to a possible rate of 12,000,000 tons. We are at present producing steel at a rate slightly under 10,000,000 tons a year. But very little has been done for very many years to increase our pig-iron capacity. Our rate of pig-iron production just now is little over 8,000,000 tons a year. As scrap supplies decline, not only shall we be unable to get our 12,000,000-ton steel-works capacity going, but we shall fail to maintain even our present 10,000,000-ton rate of output, unless we get more pig-iron.

This pig-iron problem is a case for long views. The disparity between the output of pig-iron and that of steel cannot continue. One of two things must be done. Either pig-iron must be imported, or very much more must be produced at home. For some considerable time importation will be practically out of the question, owing to transport costs, not to mention limited production abroad. It might be worth while to consider the question of erecting the necessary smelting plants on tide water in Newfoundland, or in Canada, using Newfoundland ore and Canadian fuel. But there would still remain the problem of freightage across the Atlantic. In any case, the cost of developing the iron and coal mines, erecting the necessary furnaces, railways, docks, and loading appliances, and building the special ships for the trade, would be an enormous financial proposition, and could only be successfully met by a combine of many of the big steel and engineering interests. Some manufacturers in this country seem to think that we shall be able shortly to draw good supplies of pig-iron from the United States and one or two continental countries. There is little ground for this idea. Several years must elapse before France, for instance, will have the railways and docks for a heavy export trade. And in the United States the distances which separate the coal mines from the iron ore supplies, and the blast-furnaces from shipping ports, are too great to permit of our drawing any considerable or cheap supplies of pig-iron from America, especially now that a big and permanent addition has been made to railway rates in the States. The soundest proposition would be a great increase of the very latest type of blast-furnace in this country. We have the most convenient supplies of raw materials, and we have a hungry steel-works capacity.

We are not, of course, short of furnaces, so far as numbers go, but we are short of the modern types of furnace. We have just 500 blast-furnaces in Great Britain. Only 296 of these were in blast at the end of the last quarter; just 100 were being relined. That leaves 104 dormant, neither working nor being prepared to work. Most, if not all, these dormant furnaces are old and uneconomical. With current fuel costs these stacks cannot produce at competitive prices. As the Belgians and the French gradually get more and more of their furnaces in commission, and as the Germans improve their iron ore and coal production, and costs move even slightly in the direction of normal, more or more of our old British blast-furnaces will become obsolete. All the evidence points to an urgent and imperative need for more modern furnaces in this country. What is being done?

At the moment fifteen new blast-furnaces are in course of construction—one each by the Stanton Ironworks Company, the Sheepbridge Coal & Iron Company, Bradley & Foster, Barrow Hematite, Partington Company, Ebbw Vale, Baldwins, John Lysaght, Appleby Company, Bell Bros., Lloyd's Ironstone Company, Holwell Iron Company, Shelton Iron Company, and two by Willingsworth Iron Company. In these days of costly coal, short supplies of ore, labour threats, nationalisation movements, and excessive taxation, it requires some courage to put down the almost colossal capital needed for the erection and equipment of a modern blast-furnace; but, on the other hand, unless we obtain the necessary pig-iron, and with something like economy, we shall have to give up the ghost as a steel and engineering nation. The day will come when British labour will again believe in a fair day's work for a fair day's pay, and when British politicians will return to sanity, and wise and patriotic British capitalists will make their plans now, at once, in that hope, belief, and faith. Let all our great steel and engineering firms put their heads together and proceed at once to put down the necessary cash for a big and progressive blast-furnace programme, so that, in the years to come, this country can take the lion's share of the world's great steel trade. — From November Journal, Sheffield (Eng.) Chamber of Commerce.

The rapidly developing demand for electric furnaces on the part of foreign melters of non-ferrous metals is one of the important factors in the history of this industry this year. The Electric Furnace Company, Alliance, Ohio has just shipped two 105 K.W. Baily units to Norway where they will be used to melt zinc at the Jossingfyord plant in Stavanger, and to melt aluminum at the Norsk Aluminum Works, at Christiania.

Complete rolling-mill brass-melting furnaces, designed for pouring the metal directly into the moulds, have recently been shipped by this company to the Amsinck Corporation of Mexico, Mitsui and Company of Japan, and Allen Everett Ltd., of England. The adoption of electric melting by the largest and oldest brass-tube mill in England is especially significant at this time. The Amsinck Company already had a Baily tilting-furnace for melting their brass-cartidge slab. Both furnaces are for the Mexican government arsenal. In addition to these units, Baily electric furnaces have recently been installed at there Canadian plants; The Dominion Steel Products Company of Brantford, Ontario. The Monarch Metals Company of Hamilton, Ontario, and the Union Screen Plate Company of Lennoxville, Quebec.

REFRACTORIES.

A Paper read at the Meeting of the Electric Furnace Association, Columbus, Ohio, Oct. 6th.

By C. H. BOOTH.—Booth Electric Furnace Co., Chicago.

It is a well known fact that the life of refractories has had a great deal to do with the success or failure of electric melting-furnaces. A careful study of the reasons why some of the earlier types of equipment have not met with large success will disclose that this has been due to the difficulties experienced in getting roofs and side walls to stand up. This condition has also, in many cases, limited the size of furnace which could be built. One of the best known examples which bears out this statement is the Stassano Electric furnace which was one of the earlier types of arc furnace equipment developed.

The writer has been interested for many years in the possibility of developing a type of electric-arc furnace which would show an improved life of refractories. Surprisingly good results have been secured on a two-phase, three-electrode, bottom-conducting type of arc furnace. Recent records from a three-ton furnace of this type give an average of 125 heats per roof, 275 heats per lining, while the bottom has stood up for over a year without replacement. Some roofs have lasted over 250 heats and linings as long as 475 heats. This furnace has been operating on an acid basis. The refractories used have been a good grade of silica brick for the roof and a portion of the side walls, the balance of the lining being rammed-in ganister.

But no stationary type of furnace has the same opportunity of securing long life from refractories as that where the body of the furnace is in motion during some portion of the melting period. Obviously, the best results can be obtained from a furnace in which all parts of the lining are subjected evenly to the same temperature as far as practical, and this result can be further improved if the entire lining is washed by the hot liquid bath of metal, thus aiding in cooling the refractories and securing an even wear.

In the past year and a half adequate records have been secured from a rotating-drum type, single-phase arc furnace, used principally for the melting of non-ferrous metals, to show an exceptional life of refractories. The construction of this furnace being almost like a barrel, permits the removal of the two flat heads of the cylinder so that in lining the drum, the best possible conditions are available. In practice the plan has been to lift the furnace shell off of the rollers upon which it rests, place it on one end, remove the flat end which is on top and lower the lining into the shell, piece by piece. While five or six hundred heats have been secured from linings made up from arched clay-brick, the standard type of linings used have consisted on only three or four pieces, viz: a large cylindrical tile for the body of the shell and two circular flat-end bricks for the ends. After these have been put in place, loose heat-insulating material is tamped in hard between the brick and the steel shell and after the top and brick is in place, the steel end-plate is again bolted onto the shell. The bricks described have been made a good grade of fire clay and due to the absence of joints and the rotation of the furnace, as pointed out above, results in records being made of 900 to 1,000 heats from a lining. The pouring temperature in most cases will run in the neighborhood of 2,100 to 2,200 degrees F. although many heats have been made on high temperature alloys where the temperature has averaged 3,000 degrees F. It should be especially borne in mind that the material used is only fire clay and not silica or magnesite.

The experience with this type of furnace bears out the statement that where the construction of the equipment permits the washing of the complete lining with the liquid bath the best possible life of refractories can be secured. It also demonstrates that it is entirely practical to use the ordinary class of material, which can be bought at the lowest price, and secure exceptionally long life refractories. In a short time records will be available as to life of linings used in this type of furnace for melting steel and iron where the average temperature requirement will run in the neighborhood of 3,000 degrees F. It is confidently expected that a much higher life of refractories will result than with the stationary type of electric-melting equipment under similar conditions.

A FOUNDRYMEN'S BARBECUE.

All human beings are gregarious and like to get together with some common object in view, and foundrymen are no exception. It is indeed a pleasure to meet friends, shake their hands and renew acquaintances, and we often prefer to have such meetings free from discussions of business and its attendant worries.

About six years ago, R. M. Lane had a large laboratory in Detroit where some tests in regard to core sands core binders and the reclamation of old sand were being carried on, and at that time he and E. J. Woodison got together and served what they called a coremakers' dinner. The menu consisted of baked beans, baked sausages and baked potatoes—all cooked in a core oven. Each man's individual dinner was put in a wooden bucket, which was pushed down a conveyor to a point where they could help themselves. The bucket was then turned wrongside up and used as a seat while eating the dinner.

Both gentlemen thought it would be well to have a general foundrymen's dinner again, and the long-talked of event took place on November 13th at H. M. Lane's place on Grosse Isle, Michigan, which is known as Gray Gables. This is a large island connected with the mainland by a bridge and situated about eighteen miles from Detroit. Mr. Lane secured a bear, and after properly fattening him on pears, apples and other choice foods he was turned into bear meat at the same time that a couple of sheep were turned into mutton.

Invitations were sent out to all foundrymen in this region, and the entire lower floor of the house was fitted up as a dining room, as was also a large garage and shop to the rear. About one hundred and fifty signified their intention of attending, but the other fellows evidently thought the matter over, for about two hundred and fifty showed up. Fortunately the potato crop had been so good that with the help of the meat above referred to and certain other viands no one went away hungry.

The invitation sent out consisted of a little envelope on the outside of which was printed "You'll be there to meet the bear", and the enclosure showed Bruin on the run with two sheep in advance and fate following in the shape of a knife. The non-committal barrel showed in the foreground contained cider, and this, with apples, fried cakes, nuts and the regular food on the menu, seemed to supply everybody with an ample amount of nourishment.

STORAGE-BATTERY TRUCKS AND TRACTORS IN INTER-DEPARTMENTAL TRANSPORTATION.

During the war period production in certain lines of manufacture reached its zenith, under the compulsion of national necessity, and high monetary rewards. Many industrial methods that were considered good enough in pre-war days were revised, and among the most characteristic features of war-time industrialism was the substitution of mechanical devices for man-power. Such substitution has now become an accepted standard, and workmen demand all possible mechanical helps in relieving them of arduous lifting and carrying.

Much progress has been made in inter-departmental transportation in industrial plants, where the straight-line method of progressive manufacture is assisted by mechanical means of transporting partially manufactured articles. Much non-productive labor has been cut out by carefully thought-out arrangements of this nature.

The storage-battery industrial truck and tractor is coming into much favor for inter-departmental transportation, and "Iron & Steel of Canada" has obtained from a recent bulletin of the Automatic Transportation Company of Buffalo, N.Y. some particulars of the use of electric tractors and trucks in Canadian steel and iron works. The Massey Harris Co., of Toronto, the Steel Company of Canada at Hamilton, the Cockshutt Plow Co., and the International Harvester Company are all using this method, and report saving from eight to ten men per truck employed. The International Harvester Company reports the handling of 165 tons daily using two operators with a 3-wheel tractor. The Russell Motor Car Co., and the Copper Products Company (now the Canadian Explosives Co.) report the saving of many men and teams by the use of tractors.

The combination of the electric truck with a lifting mechanism, as in the Tiering-Lift Truck, enables the stacking of goods to a considerable height. This is an important consideration in these days when, because of the slowing-up of building, storage space is at a premium.

In the plant of one steel company in Canada, where a lift-truck is employed, it is now ordinary practice to pile goods three tiers high, instead of one tier, as formerly, increasing storage capacity of this particular plant from 288,000 lbs. to 864,000 lbs. of stored material.

A load-carrying type of electric truck with a usual capacity of two tons will equal the capacity of a hand-operated truck of ordinary type, but with the electric truck a speed of from 5 to 7 miles an hour is possible. A stop-watch check on any hand-trucker will indicate that ordinary rate of travel is about three-quarters of a mile per hour.

With a higher-powered tractor, hauling say from 5 to 30 tons, a number of trailers can be moved at a like speed. The saving in time and in cost of labor is therefore very great when compared with manual operation, averaging as shown by many reports from seven to ten men per truck. Another important feature of electric-truck inter-departmental transportation is the saving of congestion and aisle-space, the factor of speed being very helpful in this way.

The foregoing particulars are condensed from an article prepared by Mr. H. S. Powley of Powley & Townsley, Ltd., Toronto.

EDITORIAL

The Raw Materials of the Steel Industry in 1920

The statistics available at the year end show the following production of domestic mines during 1920, as compared with 1919 and 1918 :

	Short Tons.		
	1920	1919	1918
Iron Ore	120,000	197,170	211,608
Coal	16,000,000	13,681,218	14,997,926
Pig-Iron	1,080,000	917,781	1,195,551
Steel ingots and castings	1,220,000	1,030,342	1,873,708

With the exception of the production of iron ore, which is to be credited almost entirely to Ontario, the figures are encouraging. A very small proportion of the welcome increase in coal production can be credited to consumption in steel-making processes. In Nova Scotia, the coke tonnage showed a decrease from that of 1919. A certain amount of coal has been used in the steel and iron trades in the West, but this, of course, is as yet inconsiderable in quantity.

The continued decline in the production of native iron ore, which now stands at the lowest point in twenty years, is disturbing, but, despite much research and many proposals for state assistance of domestic iron-ore production, the problem has received no solution on economic grounds. From a patriotic viewpoint, the situation is distinctly dangerous, but, so far, the attempts which have been made by Canadian steel companies to utilise domestic ores have received the scantest recognition from federal or provincial governments. On strictly economic grounds, this attitude is probably an irreproachable one, but economic considerations are only one phase of national life, and if Canada were to frame its policies entirely on economic grounds it would logically lead to placing our seat of government in that country where we get our raw materials. However, it has not yet been demonstrated that cheapness is the main reason for our national existence. It is quite possible also that nothing is cheap that is bought abroad when it can be produced at home. Coal and iron are two things that are cheap at any price in times of national necessity, and it may well follow that they are dearly purchased at any price abroad if thereby our own resources are unutilized and their existence practically negatived.

A year ago we ventured a hope that the revelation of Canada's deplorably subservient position in regard to supplies of coal and iron, and our exchange rate, which had resulted from the strikes of steel, coal and railway workers in the United States, would, if the independence of the Canadian spirit were interpreted as it is usually accepted and believed in—"do more to stimulate our native production of coal, iron and gold, than millions of government subsidies."

An increase of 2½ million tons in our coal production indicates that the interpretation was not a false one, but, in regard to iron-ore mining, the patriotism of Canadian steel companies has exceeded reasonable limits, and has gone largely unrewarded and unrecognised.

The Steel Industry and the Tariff

This issue of "Iron & Steel of Canada" contains the full text of a statement submitted to the Tariff Committee of the Cabinet, at a session held at Hamilton, by Mr. Robert Hobson, President of the Steel Company of Canada. The statement is a lengthy one, but we believe its publication in full is proper, and if our readers will peruse it carefully, they will recognise its importance, and the desirability that Mr. Hobson's thorough presentation of the case of the steel industry in Canada should receive the widest possible distribution and publicity.

The clauses that relate to the steel industry in the Canadian Customs Tariff are more numerous and complex than those relating to any other industry, and it is not possible to deal summarily with the subject, as all those who have studied it have discovered.

This periodical makes no apology for out and out support of tariff protection for the steel and iron trades in Canada. If a policy of tariff protection of the industry had not been adopted by Canada, and consistently followed for many years, the industry would have been non-existent. The freetrader—when

he deals in theories—says that an industry which is not self-supporting, and does not proceed from inherent natural advantages of the country in which it exists, is superfluous and parasitical. The postulate is denied, but we cannot, unfortunately, deny that our domestic steel and iron trades are not based on natural resources in the same sense that the parallel industries of the United States, Britain and Germany are based. Inasmuch as the steel and iron trades in Canada draw the raw materials for their subsistence so largely from the outside, the industry is not self-sustaining, and is, in a sense, exotic, requiring to be fostered by deliberately imposed protective duties.

We see no advantage in playing with words, or refusing to face a plain issue. The steel and iron trades in Canada ask for tariff protection because they cannot live without it, and, as we have pointed out previously in these columns, so far as the primary plants in Canada are concerned, the tariff protection has been so nicely adjusted as to keep the patient alive, but has not been sufficient to impart any robustness or energetic growth.

The situation in regard to the secondary trades is quite otherwise, but these, no less than the primary trades, are the children of a protective tariff designed to achieve precisely the object that it has achieved.

Inasmuch as the steel and iron trades of Canada proceed from and are based on a designedly artificial condition, created by our Government, and inasmuch as an abandonment of this legislative condition would involve the financial and operating collapse of the whole fabric of the industry, there does not appear to be any matter at this time that requires more attention than the securing of the retention of the protection given by tariff to steel and iron activities in Canada. The Steel Company of Canada has not minimised the importance of defending the industry, and has earned the gratitude of the thousands who depend on it for livelihood, for the painstaking analysis of the situation submitted to a Cabinet Committee that has shown much ability to sort out truth from error, and which has insisted on obtaining indisputable facts and exact detail on which to base its momentous decisions.

The fact that the desire to lower the tariff protection is based on misunderstanding in many instances, and on insincerity in others, and that the diagnosticians will undoubtedly quail before the surgical operation they think is indicated, does not excuse laxity of defense. A good cause merits a good defense, and when the Steel Company of Canada submits that the extent of the steel and iron industries "is usually accepted as a reliable index of a country's development and prosperity", the case for the industry is given in one sentence, and we do not believe the statement is capable of disproof.

BRITISH EMPIRE STEEL CORPORATION.

While no definite statement has been made by the British promoters of the British Empire Steel Corporation that the consolidation which they proposed has been abandoned in its entirety, it is understood that the project has failed of fulfillment because of the impossibility of raising in Britain and transferring to Canada, without ruinous exchange discount, the sum of twenty-five million dollars of new working capital specified in the agreement between the promoters and the Dominion Steel Corporation and the Nova Scotia Steel and Coal Co.

We have confined our comment on the project to the only feature thereof that it is within the province of a technical journal to discuss, namely, the technical operation of the coal and iron-ore properties of the two companies mentioned, which provided the primary reasons—sufficient and compelling reasons—for their single management. These reasons still exist, as does also the necessity for new working capital. It is not without interest to recall that the agreement entered into with the British promoters by the two steel companies specifically, provided that twenty million dollars of the capital proposed to be raised was to be expended in developing the operations of the two Nova Scotia steel companies, in Nova Scotia itself.

The circular sent out by the President of the Dominion Steel Corporation to the shareholders recommending the consolidation, stated:

"The improvements made to your properties "during the past four or five years have been "very extensive, and are of the most modern "character, but further important renewals and "improvements are necessary to increase output "and ensure continuously profitable operation.

"These will necessitate the expenditures of large "sums of money which the Company has not at "its command, and which must be provided "through some form of capital financing."

Precisely similar necessities accompany the operations of the Nova Scotia Steel & Coal Company.

As to the technical reasons advocating consolidation of the Dominion and Scotia Companies, these may be summed up by the statement that under single management—and in no other way—will it be possible to obtain the fullest and most profitable results from the properties of the two companies.

Therefore the reasons which first counselled consolidation, namely, economics of joint operation and necessity for additional capital, still exist. Sooner or later, and the sooner the better, these two inter-related and contiguous sets of operations must come together.

The main issue has been obscured by some irrelevancies, but these should not be allowed to disguise the fact that the value of the two sets of assets combined is much greater than their sum under divided management.

"IRON AGE" ON UNITED STATES FACTORIES IN CANADA.

This generation was taught that international commodity exchanges governed international currency-exchange rates, a fairly obvious truism, inasmuch as one is merely the medium through which the other is expressed, but, except to strict students of economics, this principle, and many others were packed away in our minds along with musty dates of forgotten kings and the names of rivers, mountains and capes that meant nothing in a workaday world. In the last few years, however, we have had to learn geographical and ethnological facts to the point of surfeit, but one thing that we have seen and are seeing to better advantage than our immediate progenitors is the working out of economic law, and in particular those that govern international currency exchanges.

"Iron Age" is a trade paper that has excellent opportunities to diagnose trade conditions, and in a recent issue points out that the high credit status of the United States, and consequent high premium on United States currency, is, in consonance with ancient laws, tending to restrict the export trade on the United States, and will in due course, if allowed to follow its full course, make the United States the creditor of a bankrupt world without means of enforcing payment of the debt.

The desirability of foreign investments of United States capital is urged, and the following comment in regard to United States investments in Canada, is interesting:

> "Even before the war there were conspicuous " examples of American manufacturers, who had " been engaged in export trade, building fact- " ories in foreign countries. Some of these fact- " ories are in Canada, and the principle involved " is just the same even though Canada is near at " hand. The manufacturer makes a foreign in- " vestment, and in a sense he maintains his ex- " port trade. He is still producing the goods the " foreigner buys, even though he produces them "in the foreign country, and the parent com- " pany receives the profit."

This is a fairly explicit disclosure of the policy of extension of the activities of United States' manufacturers to Canada; and, if it suits the United States, as it suits Canada, why should anyone desire to discourage the policy of our friends across the border? If anyone should suppose that by altering Canadian import tariffs to an extent that would cause United States' interests to withdraw from manufacturing enterprises in Canada, that thereby the Canadian consumer would get his goods at a figure reduced in proportion to the tariff impost removed, he must be an unsophisticated person, unacquainted with the commercial acumen of our southern friends or with the financial perspicacity of the Canadian brokers that would undertake the business of intermediary.

It also seems fairly clear that if by tariff changes Canada voluntarily reduces the volume of her domestic manufactures, the exchange rates on New York will move still further against Canada. The circumstance of manufacture by a firm with headquarters in New York, or headquarters in Montreal is not the relevant and determining factor. It is the circumstance of manufacture within Canada, or outside that makes us a debtor or a creditor nation.

BRITISH IRON FOUNDERS LOOKING FOR IRON ORE SUPPLIES ABROAD.

The "Mining Journal," of London, states that there are at the close of the year 100 idle blast furnaces in Great Britain, and attributes this slackness, not to lack of business, because it is stated that Britain is "starving for want of pig-iron," but to inadequate production of coal and coke.

The following reference to Canadian steel companies, and to the Wabana ore deposit, indicates that British steel-makers are anxious about their ore supply. There is little doubt but that the Wabana deposit is the largest available source of iron-ore supply within convenient shipping distance of England, and, if consideration is confined to sources of supply within the British Empire, outside of Britain itself, it is virtually the only source of supply.

The comment referred to is as follows:

"But although the chief, the coal shortage has not been the sole restrictive influence at work in the iron and steel industry. Almost equally serious have been the dwindling supplies of native ironstone and limestone. This question of the maintenance of adequate supplies of raw material has, in fact, become the main concern of the manufacturer, and the whole trend of events in recent years has been in the direction of the acquisition by the big steel producing firms of control over the sources of supply. Of this the most notable example in the past year has been the projected alliance between big British steel firms and the Dominion Steel Corporation of Canada, which would give home manufacturers access to and partial control over some of the richest mineral deposits in the world. High freights have as yet prevented a resumption upon a large scale of the shipment to England of the rich Wabana ores which are highly suitable for basic iron production, but one or two experimental shipments have been made to the Tees, and unless the alliance is abandoned, as is now reported to be likely, these ores, will again be shipped here as they were in pre-war days on a large scale, as soon as the now rapidly dwindling freights make it commercially profitable. Messrs. Dorman, Long & Co. Ltd, some time ago also acquired interests in the Itabira mines of South America, and other firms are questing further and further afield, Sweden, France, Spain, North Africa, Syria, the Caucasus, and far-off India, all being laid under regular tribute to keep up the flow of iron ore to the furnaces of Britain. At home, too, the quest continues, and deposits once thought too lean to be profitably worked are now engaging attention as the richer deposits approach exhaustion.

The Steel Industry and the Tariff

Being a Statement submitted to the Tariff Committee of the Cabinet at Hamilton, 25th September, 1920, by the Steel Company of Canada.

In presenting to your Committee our views in regard to the position of the Steel Industry under the present Tariff, we have divided our Brief to cover this subject into three parts;

I. The need of adequate protection for the proper growth of the Steel Industry.

II. The low rate of protection afforded under the present Tariff.

III. The probable effects of the adoption of a Free Trade policy.

1. The need of adequate protection for the proper growth of the Steel Industry.

Steel a Basic Industry.

In the consideration of this question regard should be given to the fact that the Steel industry is one of those known as a basic or key industry. The products of the Blast furnaces and Steel Mills constitute the source of supply of the raw materials used in a very large number of dependent industries, such as car and locomotive building, foundries, machine shops, agricultural implement works and manufactures of a vast variety of articles. It has, therefore, been rightly stated that no country can progress industrially unless it possesses a well established steel industry. Not only is steel an essential factor in the industrial development of the country but it is of great importance in connection with all construction work, railroad and similar development and the steel industry is usually accepted as a reliable index of a country's development and prosperity.

Lesson of the war.

It will be recalled that the industrial situation in Canada during the War was very largely dependent upon our ability to engage in the manufacture of munitions and the extent to which this was possible very largely depended upon our ability to furnish the necessary raw materials of which Steel was one of the most important. From the standpoint of the country as a whole, the period of the War amply demonstrated the wisdom shown in developing this industry in Canada, and yielded tremendous benefits to industry and labour, as well as benefitting the financial position of the entire country. In other countries, the experiences of the War have firmly established the fact that a large degree of independence must be preserved in respect to the products of basic or key industries. There were many occasions during the War period when supplies of Steel and other important raw materials were unobtainable from outside sources of supply and were subject to embargoes and other restrictions which would have very seriously affected our War effort and business conditions in general, had we not been able to furnish the most important wants from our own sources of supply. Such experiences should not be forgotten, as ample proof was given during these times that any country with National aspirations cannot afford to be commercially subservient to another without sacrificing, to a considerable degree, its capacity for independent action.

Canadian Steel.

The manufacture of Steel in Canada is of comparatively recent growth as up to the year 1900, steel was produced in very limited quantities and practically entirely for the production of steel castings. In 1900, production of all kinds of steel ingots and castings in Canada amounted to less than 25,000 gross tons. The figures showing the subsequent growth are as follows:—

1900	23,577	gross tons.
1910	741,924	" "
1917	1,562,289	" "
1918	1,673,214	" "

The contrast shown by the figures seems to indicate that the growth has reached fairly large proportions but our production figures are insignificant in comparison with the great commercial Nation to the South of us, which has an annual productive capacity of 45,000,000 to 50,000,000 tons per annum.

Canadian Output versus United States.

The present position of the Steel industry in Canada is perhaps better exemplified by the statement that there are single plants in the United States, owned by a single Company, where the production of steel is greater than it is for all of Canada. The situation at present time, viewed from the standpoint of the annual output, shows that the production of the steel industry in Canada approximates the Steel production of the United States in the year 1885, when statistics show that the United States produced 1,712,000 gross tons—somewhat larger than the Canadian production in 1918, which was largely stimulated by War requirements.

Regard should be given, in this connection, to the steady development of the Steel industry in the United States under a protective policy. That it has been marked will be noted from the following figures:—

	1879	935,000	gross tons.
10 years later	1889	3,386,000	" "
10 " "	1899	10,640,000	" "
10 " "	1909	23,955,000	" "
9 " "	1918	46,000,000	" "

It will be observed that during each decade the output of steel has doubled and the expansion of industry in general in the United States, in many lines dependent on steel as a raw material, has been commensurate with the growth of the steel industry.

The progress made by the industry in Canada has been slower than it might have been due to the fact that it has been constantly subject to keen competition from American mills. Shipments from producing points like Bethlehem, Pittsburg, Buffalo, Youngstown, Cleveland, Detroit, Chicago and Duluth, can be made to Canadian points of consumption as readily as from the Canadian mills.

The tremendous advantages of the self-contained operations of United States' mills are strongly emphasized by the position of the United States Steel Corporation which owns its own ore, and coal mines, its own lake steamers, and operates its own railroad

for the transportation of ore. A conception of the ramifications of this company may be gained from the following figures:—

Ingot capacity	22,000,000	g. t. annually.
Ore mined	30,000,000	" "
Coal mined	30,000,000	" "
Steamers and barges owned	371	" "
Freight cars owned	62,000	" "
Locomotives owned	1,400	
Miles of railroad	3,700	
Number of Employees	250–260,000	

This Company operates 145 Works, comprising,—
124 Blast Furnaces
373 Open Hearth and Bessemer furnaces
624 Rolling Mills
74 Wire Mills
51 Tube Mills

besides various subsidiary industries. These mills are located at various points in the United States, as follows,—

Worcester in Massachusetts.
Allentown and Pittsburg in Pennsylvania.
Trenton in New Jersey.
Youngstown, Cleveland, Lorain and Columbus, in Ohio.
Chicago, Gary, Joliet and Waukegan, in Illinois.
Duluth in Minnesota.
Birmingham in Alabama.

We have simply named the principal points to illustrate the strategic position they possess in reaching various points in Canada, in competition with which Canadian manufacturers are forced to absorb freight differentials by reason of the superior advantages of this competitor.

There are other very important steel producing interests whose tonnages, in each individual case, are greater or practically equal to the entire Canadian production, as follows:—

	Annual ingot Capacity.
Midvale Steel & Ordnance Co. with mills at Philadelphia, Coatesville and Johnstown, Pa..	2,750,000 tons
Bethlehem Steel Company. Bethlehem, Pa. Baltimore, Md. etc	3,500,000 "
Lackawanna Steel Company. Buffalo, N.Y.	1,800,000 "
Jones & Laughlin Steel Co. Pittsburg, Pa.	1,750,000 "
Republic Iron & Steel Co. Youngstown, Ohio	1,500,000 "
Youngstown Sheet & Tube Co. Youngstown, Ohio	1,500,000 "
Inland Steel Company. Chicago, Ill.	1,000,000 "

In connection with their exports business, a number of the Steel interests in the United States, some named above and others, have formed, for the purposes of handling their export business, a company which maintains offices at various points in Canada and controls the export share of an annual ingot tonnage approximating 12,000,000 tons. The above figures are quoted, not with any idea of denying their right of access to the Canadian market but to emphasize the natural inclination on the part of these large Steel interests to seek business in Canada in the same manner as they sell to their domestic trade, and to show that the steel industry in Canada is subject to the keenest competition from producing units having advantages in the way of capacity, as well as an ability to ship into our markets with the same facility as would surround the transaction of domestic business. The adjacent character of the two markets and identical nature of the demand must necessarily subject Canadian conditions to the immediate effect of any influences governing the United States' market and any lessened demand from their domestic market immediately results in a concentrated effort to unload surplus products on this market.

Canada's Territory and Population compared.

The power of such advantages as have been referred to will be more fully understood by a comparison of the Canadian market with that of the United States in respect to population and territories. Canada has territorial boundries almost similar in extent to those of the United States but our population is comparable with that of the States of Pennsylvania, actually somewhat less, and we have, in the whole of Canada, about 2,000,000 less population than the single State of New York. Canada is a wide-spread and necessarily business must be secured from a wide stretch of territory. This means that, in competition with American mills more advantageously situated, the Canadian seller is required to equalize freights frequently making it necessary to substantially reduce the actual yield derived from a certain market level. Our limited population requires that business must be done on a similar scale of operations. Tonnages are necessarily limited, although the range of sizes and kinds of goods in demand are as broad as similar lines offered in the United States' market. It will be readily understood, therefore, that in manufacturing processes, where tonnage or quantities are an important factor in economical production, that industry in Canada requires reasonable protection in order that the business may de developed to such an extent that production is sufficiently large to secure the economies obtainable from a larger output.

Comparison of Modern Rolling Mills.

This is particularly true of the steel industry where tonnage is a prime factor of economical production in large units. Our units of manufacture are necessarily less extensive and must be suited to the tonnage available, particularly with regard to the demands for specific sizes and kinds of products. This may be illustrated by the comparison of a modern rolling mill, largely operated by mechanical means, with an output of 12,000 to 15,000 tons a month, with the old style hand rolling mills, many of which are still in existence and having a capacity of between 1,500 to 2,000 tons per month. Between these extremes there are mills with varying capacities and naturally cost of production is dependent upon the tonnage rolled, both with respect to cost of labour, coal, power, and overhead. A mill of the most modern type, with a heavy tonnage, would be entirely unsuited to the Canadian market because such mills must be operated constantly and with few changes. Only one size can be rolled at one time and we could not hope to collect a sufficient tonnage of any one size to operate such a mill for any length of time, and therefore, frequent changes in rolls would be necessary with a consequent loss of time which would absolutely nullify the value of the investment. Such an installation of the most modern

type involves an expenditure of about 3,000,000, a fact which exemplifies the cost of development in the steel industry, besides the constant necessity of making provision to discard obsolete and out of date machinery and equipment.

One of these modern mills was started, not very long ago, in Youngstown, Ohio. The initial order was one involving between 6,000 and 7,000 tons of ½-in. rounds, enabling them to run the mill for days on this size, guaranteeing the maximum output by reason of the consistency of operations. In business in Canada, we have practically to figure in hundreds of tons where competitors in the States figure in thousands of tons. No amount of expenditure, energy or brains can equalize such conditions, although they will be attainable with the growth of the Canadian market.

Effect of Freight on Costs.

The development of this country has naturally run along lines from East to West. The position, therefore, of steel producers is that business is done over a wide-spread territory, making it necessary to seek business from points where advantages are possessed by American mills by reason of their location or nearness to the market of consumption. This makes the question of rail freights one of prime importance in relation to the question of protection, and, in this connection, it should be pointed out that costs of manufacturing steel are largely contributed to by the higher rates of freight which have been found necessary to support the position of the railroads. This will be understood when it is realized that it requires four to five tons of raw material, ore, coal, coke, ingot moulds, bricks, supplies and repair material, for each ton of finished steel shopped out. The advance in freights, as affecting the cost of assembling the four or five tons of material required, is, therefore, an item of considerable importance particularly as central Canadian mills have a long haul on their prime raw material, ore and coal, by reason of their dependence for such materials on the American fields.

Exchange and Value for Duty.

The matter of exchange as related to value for duty purposes will be of much importance as foreign producers regain their normal production. The Government has seen fit to rule that foreign coinage, when expressed in Canadian currency for Customs' valuation, shall be taken at current rates of exchange. At present the Pound Sterling, French and Belgian franc and German mark are at a discount varying from over 20 per cent in the case of the pound, to about 90 per cent for the German mark. It will be seen, therefore, that prices expressed in currencies which are so debased will invite exportations to Canada, as it always follows that a country, with its currency at a premium as related to other countries, becomes a good market in which to sell, and, therefore, our market in Canada would be attractive to the countries mentioned, all of which are much larger producers of steel than this country. This feature of the situation alone supports the statement that the present is a most inopportune time to change our tariff policy.

Figures already presented have shown that our steel production in 1918 showed figures comparable with United States Output of 1885. Eliminating the effect of the war's requirements, it is probable that we should require to go further back in order to make a fair comparison, but any consideration of our industrial position in Canada must take into account the fact that in the year 1850 the population of the United States numbered over 23,000,000 and their output of steel ten years later, with a population of 31,000,000 had not reached 1,000.000 tons. Today, individual plants, under one management and overhead costs, in the United States, have a productive capacity of 2.000,000 tons of ingots, i.e., more than the entire Canadian steel production, and it must be evident that, with the economies to be derived from tonnage production, Canadian plants would be unable to equalize such advantages unless afforded a reasonable degree of protection. The growth of the steel business in the United States wa made possible by the policy of protection.

The McKinley Tariff of 1890 established a confidence which is evident by the growth in the production figures which subsequently followed, as illustrated in the tonnage statistics already quoted. These figures give some conception of the hopes which may be entertained with respect to the development of the steel business in this country and it is certain that, with increased production, will come greater efficiency and lower cost of production, because it seems reasonable to believe that, on account of the similarity in the needs of the two countries we may look for a relative degree of progress and development provided our fiscal policy is directed along sound lines.

In order to give some figures representing the importance of the steel industry as related to the business life of this country, the following may be of interest as representing the total number of employees, aggregate amount of wages paid, and freight paid by the four largest steel companies of this country, viz:—

The Algoma Steel Corporation, Limited.
The Dominion Iron & Steel Company, Limited.
The Nova Scotia Steel & Coal Company, Limited.
The Steel Company of Canada, Limited.

Year.	Total No. Employees.	Total Wages.	Total Freights Paid.
1915	17,387	$13,495,929	$4,733.662
1916..	21,122	20,638,103	7.957,149
1917	20,292	24,428,594	8,697.986
1918..	19,026	26,706,451	9.236,526

Figures are given for these four companies as they represent the producers of Basic Steel Products manufacturing semi-finished and finished steel products from the ore. An estimate of the total investment in these four concerns is probably approximately correct at $200,000,000 and it is only through the development of self-contained organizations producing steel from the basic materials, such as ore, coal, etc., that we may hope to place the production of steel in Canada, on a proper basis.

Figures representing wages paid by the Steel Company of Canada alone and number of employees for the year 1919 are as follows:—

Employees..	6,062
Wages..	$8,238,713

It is not out of place here to emphasize what the production of basic steel involves in the way of capital investment. Most of the steel companies in Can-

ada have been forced in recent years to discard the old Bee-Hive coke ovens, or other types of ovens, in favour of By-Product Ovens. To install 80 ovens, required by this company to produce its consumption of coke, involved an outlay of $3,500,000. A single blast furnace, complete with stoves air engines and other equipment, would today probably involve a cost of $3,000,000. These are instanced to give you an idea of the amount of capital that has to be risked in the consummation of any plans looking towards larger outputs and more economical production. A blast furnace is simply a single unit for the production of Pig Iron—must be of modern type and dimensions and consequently, the expenditure, as a whole, must be undertaken at the one time. These figures are given to establish the necessity of considering the subject of Tariff rates on iron and steel products from the standpoint of the basic producer.

11. The low rate of protecton afforded under the present Tariff.

Specific Duties.

The exhibit of duties levied under the present Tariff, on various Iron and Steel articles which are shown below, indicate that the majority of the heavy tonnage lines are protected by specific duties. The change which values have undergone during the past six years shows that these specific duties, as related to current values have steadily declined in the percentage of protection afforded by the Tariff. It is true that these percentage figures will rise or fall with changing values but it is generally conceded that the higher range of commodity prices in general will be more or less permanent and, therefore, the percentage of Tariff protection afforded by specific duties will suffer a permanent reduction.

The following figures which have been taken from "Iron Age" of New York, issue of September 16th, 1920, show the present rate of duty and the percentage it bears to the price f. o. b. Pittsburg. American market prices are quoted because this market has been the determinating factor in the world's steel prices for several years past:

Exhibit of Duties.

Commodity	Prices F. O. B. Pittsburg.	General Tariff Duty.	Gen. Tariff Duty % to Pittsburg Price.
Foundry Pig Iron	$50.00 g.t.	$2.80	5.6%
Steel Billets	$60.00 "	$2.80	4.7%
Wire Rods	$70.00 "	$3.92	4%
Steel Bars	$65.00 n.t. base, 1.50 avg. extra		
	$66.50 n.t.	$7.00 n.t.	11%
Iron Bars	$95.00 1.50 avg. extra		
Structural Shapes	$96.50	$7.00 n.t.	7½%
35 lbs. and under	$62.00 n.t.	$7.00 n.t.	11%
Over 35 lbs.	$62. n.t.	$3.00 n.t.	5%
Plates	$65.00 n.t.	$3.00 n.t.	4½%
Wire Nails	$4.25 per keg base .40 avg. extra		
	$4.65	.60 a keg	13%
Galvanized Sheets, 28 ge. base	$9.00 per 100#	12½%	12½%
Galvanized Sheets, 28 ge. base	$7.50 " "	12½%	12½%
Black sheets, 28 ge. base	$9.00 " "	12½%	12½%
Barbed Wire	$4.60 " "	Free	Free
Galvanized Fence Wire, #9 gauge	$4.45 " "	Free	Free

In quoting the above Pittsburg prices, it should be stated that these prices govern the whole United States, market and prices for Eastern and Western territory are based thereon. That is mill prices for shipment to the Western States would be the Pittsburg price, to which would be added the full freight Pittsburg to destination.

It should also be stated that prices quoted above are domestic prices which, in the majority of cases, are named for home consumption and for shipment to Canada, as higher prices are being quoted for shipment abroad. For several years past it has been the policy of the American Steel manufacturers to quote domestic prices in most cases for shipment to Canada while, for shipment to Europe and other countries, higher prices f.o.b. mills have been obtained.

Heavy Importations.

It is clearly shown by the above figures that the protection afforded by our present Tariff is extremely moderate, in fact low and, in certain tonnage lines, our heavy importations are due to the fact that the Tariff protection afforded is not sufficient to encourage their manufacture in Canada. A study of our import statistics emphasize that the manufacture of Steel in Canada has been subjected to intense foreign competition. Figures for the five calendar years, available up to 1918, taken from statistics of the Department of Mines show the following:

Total Imports of Iron and Steel into Canada. Calendar Year.

1914	1915	1916	1917	1918
Pig Iron, Forgings, Castings and Rolled Iron & Steel Products.				
Tons	Tons	Tons	Tons	Tons
878,179	771,007	864,916	929,776	786,097
$28,825,373	$27,504,685	$52,114,258	$84,448,580	$70,493,861
Other Iron & Steel Products.				
$51,238,306	$46,804,298	$76,975,990	$102,089,958	$99,044,808
Total Value.				
$80,036,679	$74,308,983	$129,090,248	$186,538,538	$169,538,669

The figures for 1919 and 1920 as given in Trade and Commerce Blue Books, years ending March 31st, 1919 and 1920, show total value of all importations:

March 31st, 1919—$185,282,488
March 31st, 1920—$189,907,602

Plates and Sheets.				
Tons	Tons	Tons	Tons	Tons
227,633	224,484	225,439	185,074	158,613
$ 7,877,729	$ 7,647,560	$12,806,096	$ 17,582,700	$ 14,114,139
Tin Plates and Sheets.				
Tons	Tons	Tons	Tons	Tons
50,791	45,165	57,543	66,676	72,844
$ 3,151,385	$ 2,883,951	$ 5,221,163	$ 9,985,631	$ 11,403,887
Bars, Rods Hoops, Bands, Etc.				
Tons	Tons	Tons	Tons	Tons
148,368	156,990	198,654	228,512	171,116
$ 5,138,193	$ 5,829,088	$ 13,352,807	$ 22,567,187	$ 17,849,982
Structural Iron & Steel.				
Tons	Tons	Tons	Tons	Tons
160,538	126,780	158,905	185,965	145,215
$ 4,214,520	$ 3,615,333	$ 8,042,127	$ 15,282,012	$ 11,004,159

To a considerable extent these heavy importations are due to the many anomalies and exceptions which appear throughout our Tariff and which exempt steel from the payment of duty when used for certain purposes.

Steel for Farm Use.

Special consideration has been provided in our Tariff for the free entry of steel from the standpoint of its use on the farm and the needs of the farming community have been supplied, to a very marked extent, much greater than is generally realized, by steel which has paid no duty when entering Canada. In the aggregate the tonnage exempted amounts to very large figures and the business cannot be participated in by the Canadian Steel manufacturer except at prices which would, under ordinary conditions, be quite unprofitable.

Steel enters Canada free of duty or subject to 99% drawback.

The following is a list of those articles in the manufacture of which Steel enters Canada free of duty, or is subject to a drawback of 99% of the duty paid,—also a list of the finished or semi-finished steel which enters Canada under similar conditions:

Steel for

Axes, Hatchets, Scythes, Reaping Hooks, Hoes, Hay or Straw Knives, Agricultural forks, Hand rakes, Windmills, Mowing Machines, Reapers, Binders, Parts of attachments for binders, Harvesters, Cream Separators, Saws and Straw Cutters, Mower and Reaper Knives, Bow sockets for buggy tops, Harness and saddlery hardware, Mould Boards or Plow Shares, Galvanized Fencing Wire, Galvanized Barbed Wire.

Axles and Spring for Waggons, carriages and automobiles, Corset Steel, Clock Springs, Shoe Shanks, Buckle Clasps, Bed Fasts, Furniture Castors, Ice Creepers, Corset Wire, Locks, Door Knobs.

Cutlery, Files, Augers, Auger Bits, Bit Braces, Hammers, Skates.

Stove Trimmings, Bicycle Chains, Railway Spiral Springs, Spoons, Horse Nails.

Steel enters Canada Free of Duty and Subject to 99 p.c. drawback.

Also Free Entry is accorded—

Galvanized Wire, 9, 12 and 13 gauge,
Barbed Wire,
Steel Bowls for cream separators,
Traction engines,
Boiler plate for boilers,
Hoop Steel for Galvanized Hoops,
Black Sheets for Galvanized Sheets,
Wire for Wire Rope,
Locomotive and Car Tires,
Tubes and Plates for gas buoys,
Wire for Mattresses,
Wire for nailing machines,
Tubing for bedsteads,
Tubing for carriage rails,
Skelp for bedstead tubes,
Angles for bedsteads,
Hexagon bars to be cold drawn or rolled,
Sheet bars for manufacture of sheets.

In addition to which Steel Beams, Angles, Sheets, Plates, Masts, Knees, Cable Chain for Ships, enter free, in fact, all Iron and Steel used in the shipbuilding trade is subject to drawback of 99 per cent of the duty.

Only a careful study of the iron and steel schedule of our Tariff with such an exposition of the various lines for which steel enters Canada free of duty can adequately give a proper idea of the very heavy importations which have occurred and it is equally specially desirable that it should be realized that already the needs of the Farming community are receiving preferred consideration to an extent which is probably not understood even by the Farmers themselves.

In order to connect the above list with the Tariff items which cover these various articles, they are as follows:—

No.	No.	No.	No.
380	465	478-A	746
384-A	470	479	1,002
403-A	472	481	1,005
404	473	482	1,006
411	475	486	1,007
444	476	486-A	1,008
458	477	729	1,009
459	478		

Item No. 1,002.

Item No. 1,002 is a very important one as it provides, in the interests of the Farming community, a drawback of 99 per cent of the duty on all Iron and Steel imported which enters into the manufacture of reapers, harvesters, binders and mowers, and attachments to binders. In the aggregate, the importations under this item No. 386 which, in former years, until a recent change, accorded entry of thousands of tons of Bars at the rate of 5 per cent general tariff and Free from Great Britain.

Figures as at year ending March 31st.

Bars, rolled Item No. 386.

1916	1917	1918	1919	1920
Tons	Tons	Tons	Tons	Tons
14,064	31,725	97,196	68,492	53,086
$ 1,838,308	$ 4,891,744	$ 12,740,208	$ 10,115,846	$ 6,926,846

Bars, rolled, Item No. 378.

Tons	Tons	Tons	Tons	Tons
69,648	75,660	49,393	51,751	34,412
$ 2,516,620	$ 4,012,135	$ 3,237,190	$ 3,213,900	$ 1,854,011

Attention should also be drawn to the heavy importations in the way of Galvanized and Barbed Wire, which are accorded free entry and which are exempted from duty in the interests of the farm,—

Figures as at year ending March 31st.

Galvanized Fence Wire & Barbed Wire.

1916	1917	1918	1919	1920
Tons	Tons	Tons	Tons	Tons
54,764	41,464	39,172	31,034	40,218
$ 2,657,599	$ 2,717,330	$ 3,078,074	$ 2,573,433	$ 3,142,349

Inconsistency of the Tariff.

No definite plan, however, has apparently guided the preparation of the Iron and Steel schedule of our Tariff as its inconsistencies are quite apparent, protection being accorded certain materials which, when carried to a further stage of manufacture, are permitted free entry.

In the matter of Sheets, for instance, this Company made an investment of over $425,000 for the purpose of establishing the only Sheet Mill in Canada, subsequently, on January 19th, 1917, an Order-in-Council was passed (Customs' Department Memo. 2052-B) exempting Black Sheets from the payment of duty, thereby according them free entry when used for the manufacture of Galvanized Sheets. The situation, therefore, is that the manufacturer of Steel (with his investment in coal and ore mines, manufacturing the Pig Iron which is used, in turn, to produce the Steel Ingots, then rolled into a bloom, again rolled into a sheet bar, and sheet bar used in the manufacture of sheets) is placed in the ridiculous position of competing against free Sheets which may be imported by any one who chooses to put in a galvanizing pot.

In order to produce our sheets as economically as possible, we made a further investment of over $350,000 in a sheet bar mill for the production of Sheet Bars and, on September 15th, 1920, Customs' Department Memo. 2418-B, an Order-in-Council was passed permitting the free entry of Sheet Bars. Here we have Pig Iron protected, Ingots protected, Blooms protected and Sheet Bars Free.

Fundamentals of Steel Production.

The big investment in the manufacture of steel is represented by the installation required for the production of Steel in its raw forms and the inconsistencies of our Tariff policy, as exemplified by the instances above referred to, can only have the tendency of discouraging proper development of the Steel Industry. If we are ever to produce Steel cheaply and economically, it can only be through its production in large quantities and the many free items, exemptions, drawbacks, etc., have been a constant source of discouragement and uncertainty to the Steel producer. We shall always be dependent upon outside markets and will continue to import heavily for our various needs, if our Tariff is not to be framed in support of the position of the Steel producer.

The development of the Steel industry in other countries has proven that, to successfully withstand outside competition, any producer must be self-contained, *i.e.*, must be independent and own their own supplies of Ore and Coal and must produce their own Pig Iron and carry the sequence of operations right through from the Ore to the finished article. This involves a very heavy investment in relation to the value of the goods marketed and the heavy share of the investment, as already pointed out, is involved in the ownership of mines, and the plant and equipment for the manufacture and production of the raw steel. It will be realized, therefore, that the exemption of any finished article from the payment of duty absolutely nullifies the large share of the investment of the steel manufacturer, made for the production of the basic material.

III. The probable effects of the adoption of a Free Trade Policy.

Effect of Free Trade.

The result of a change in our fiscal policy, whereby the policy of protection would be relinquished in favour of one advocating Free Trade, would assuredly spell ruin for the industry in Canada. The fact that, during recent years, the figures representing exports have shown considerable growth may be ascribed to the abnormal conditions which have prevailed, under which Munitions figured largely in our exports and during which period the productive capacity of other Nations was otherwise engaged, or, industrial conditions were so demoralized as to make their activity only a share of their productive capacity. Apart from these conditions, a very fair share of our exports have been based upon the use of imported raw materials which are subject to drawback of duty when exported in the finished article.

Foreign Competition.

From the world's requirements of Iron and Steel, the export tonnage of Germany, amounting to some 5,000,000 tons before the War, has been practically unavailable and, with the return to normal conditions and the consequent increase in European production, the possibilities of export trade will undergo a marked change. Already German and Belgian products are being offered to the British, Canadian, and United States' markets at much lower quotations than they have heretofore been able to quote. A recent report regarding the present situation in Belgium is to the effect that their current coal production figures are running about 98 per cent of those shown in 1913, and steel production at 61 per cent. Offers of German material have been made in various neutral markets and their active competition is to be expected with the improvement in their industrial conditions, which is bound to occur.

The effectiveness of German and other competition, on the basis of the low rates of Exchange already referred to, can be easily appreciated. German competition, for instance, on the basis of low rates of Exchange, is sure to be a most important factor in the near future. It would be manifestly unfair to Canadian labour to subject it to the free competition of German labour paid on such a rate as would be represented by Exchange values of 1½ cents or 2 cents to the mark. This abnormal situation is sure to develop conditions which may require the special study of your Government as to the position in which Canadian labour will be placed as affected by competition from labour in countries where the coinage is very much debased in relation to our currency. Not only could we not afford to consider subjecting Canadian labour to such competition under Free Trade conditions but

special consideration may have to be given the importation of German goods, in order to d justice to the workman and manufacturers of this country.

United States' Competition.

The question, however, must also be viewed from the position which we occupy in Canada as related to the competition which would have to be encountered under Free Trade conditions. With a boundary extending nearly four thousand miles, East and West, dividing us from the greatest Steel producing Country in the world, whose capacity is over twenty-five times that of Canada, it requires no vision to foresee that our markets would be dominated entirely by our more powerful neighbor, with its mills dotting the country from East to West. Appended hereto will be found a map of the United States, showing the location of its principal points of production and its immense coal and ore areas. Subjected to the free entry of steel products, Canada would then find her own market wide open to this competition and the United States' market barred in most lines from the possibility of participation in business to be secured from that source. The consequence of such a policy must inevitably result in their domination of our markets. It may be argued that a country's trade must strike a fairly reasonable balance, having regard to imports and exports but the same argument confirms the necessity of a protective Tariff as a means by which any country may have some control over the channels of trade and, in order that it may encourage and pursue that trade when it is in its interests to do so, and control such trade as will affect its best interests.

British Preference.

The question of extending the British Preference is also a matter of much importance. It has already been shown that our General Tariff items, covering numerous articles of Iron and Steed manufacture, are extremely low and these are still further reduced under the present British Preference.

Atlantic Freights.

Added to this Preference, we have another condition at the present time which still further assists the position of the British manufacturer in developing trade within the Empire. Atlantic freights from Liverpool to Montreal on various lines of Iron and Steel, quoted in Sterling, figure, at current rate of Exchange ($3.85) from 25½ cents to 40 cents per 100 lbs. For the opposite movement Montreal to Liverpool rates, on similar commodities, are from 44½ cents per 100 lbs. to 58 cents. Taking Steel Bars, one of the most important lines, the comparison is:—

	Cents Per 100 lbs.
Montreal to Liverpool	44½
Liverpool to Montreal	25½
Difference in favour of Imported Bars	19

The British exporter has, therefore, a lower rate by almost $4.00 per ton in reaching the Canadian markets. In contrast with these Ocean freights (which, at the present time, are tending downward) it will be immediately noted what an advantage there is in reaching a market by means of water, as compared with rail transportation, from the following rail rates on Bar Iron and Steel from Hamilton to Eastern points, &c., as compared with the Ocean rates on Steel Bars, Liverpool to Montreal, of 25½ cents per 100 lbs., the rail rates on similar products shipped from Hamilton to Eastern points are as follows:—

Rates on Bars.

		Cents Per 100 lbs.
Hamilton to	Montreal	34½
do	Quebec	59½
do	St. John	59½
do	Halifax	74
do	Sydney	82½

Steel for Agricultural Implement Trade.

Apart from the consumption of steel for railway purposes, the agricultural implement industry is the largest consumer of steel products. At the present time, at least 50 per cent of their steel requirements for the manufacture of machines for domestic use is accorded free entry by means of drawback privileges. Taking into consideration also that quite a large tonnage of steel is used by agricultural implement manufacturers in connection with export business, it will be readily seen that, in competing for the aggregate needs of the trade, the steel manufacturer is facing almost Free Trade conditions. Any further endeavor, therefore, to follow the advocates of Free Trade in the direction of wiping out duties on agricultural implements and materials would not only seriously affect the position of the agricultural implement trade but would also rob the Steel industry one of its largest trade demands, involving a tonnage which would constitute a tremendous set-back to the steel production of Canada and to this Company in particular.

Heavy Importations.

The heavy importations, as exemplified by the figures shown, amply demonstrate that reasonable protection is necessary to properly support the development of the Iron and Steel industry in Canada in order to withstand the preponderating advantages of the competition of United States mills.

Adequate Protection Necessary.

From the standpoint of our exchange and from the standpoint of the country's debts, Canada must endeavor to reduce her importations. From the standpoint of labour, we must continue to have regard to the general interests of the country and frame our fiscal policy in the interests of the Nation as a whole and not in favour of any particular class. At a time when other countries are conserving their home markets and increasing the protection afforded home industries, at a time when we are facing, at some period in the future, the inevitable re-adjustment which must follow abnormal conditions of the War, it must be recognized that any radical change in our fiscal policy can only be attended with very serious effects upon the prosperity and welfare of the whole country.

The Electric Furnace Company, Alliance, Ohio is installing a completely automatic heat-treating set at the new plant of the C. H. Willys Company of Marysville, Michigan. The set is designed to treat all kinds of automobile parts and consists of a 200 K.W. hardening furnace, a motor operated quench, and a 200 K.W. drawing furnace. A 200 K.W. Baily annealing furnace is being installed at the Springfield plant of the Ohio Steel Foundries Company and a similar outfit but with 300 K.W. electrical capacity has been ordered for export to the Oddehome Steel Corporation of Norway.

Iron Ores of Commerce with Special Reference to Canadian Deposits

By SAMUEL GROVES, Ottawa.

(Continued from Page 332, December issue.)

BROWN HEMATITE.

In the hematite production allocated to the leading industrial countries, all can not be described as "red" ore, for much of the metallic-mineral mined is friable limonite or "brown" hematite, coming under classification of "hydrates." And since this class of ore is also of commercial importance, its technics should not be overlooked.

The brown hematite ores consist, essentially, of hydrated ferric oxide, the chemical composition of which, in a pure state, may be taken as, ferric oxide 85.6, water 14.4 per cent. They are of later geologic time than the red hematite, and have a different origin: coming into existence as the result of the disintegration and alteration of other ores or minerals containing iron, such as pyrite, magnetite, siderite, ferriferous dolomite, etc., and caused by exposure to moisture, the action of air, and the decomposing agency of carbonic or organic acids.

Three hydrated oxides are known in commerce: limonite, gothite, and turgite. The one most commonly used is limonite. ($2Fe_2O_33H_2O$), which when pure, contains about 60 per cent of iron. The name "limonite" is derived from the Greek word "leimon," meaning meadow or swamp, since it is mostly found in marshy places, and the bottom of lakes, into which the ingredients composing the ore have been carried by streamlets from the surrounding hills. Limonite does not crystallize, but in structure varies greatly: some ores being hard and compact, with no particular structure, while others are hard, but on fracture present a fibrous, stalactitic appearance. The commonest. however, are the ochreous kinds, having a yellowish-brown colour, and contain much earthy matter, such as clay, sand, etc. The rich, brown, pure, limonite ores, do not exist to any extent in nature. The lustre of the harder ores is silky, varying from sub-metallic to earthy, and the material opaque. The hardness is 5, and the specific gravity about 4.

Brown hematite may readily be distinguished from red hematite by the streak, for whatever may be the external colour of a comparatively hard piece of anhydrous hematite ore, it always shows a "red" streak if scratched by something harder than itself; but hydrated hematite, if treated in like manner, will invariably exhibit a "brown" streak. Deprive limonite of its water, and it becomes hematite.

Deposits of brown hematite are found in bog and lake all over the globe, and in ancient times and the Middle Ages, were more extensively used than either red or black ores. In the seventeenth and eighteenth centuries, however, bog and lake ores were practically abandoned, owing to the invention of the blast furnace, and the discovery of richer, purer, more extensive, and more economically mined beds or iron ore, Finland—"the land of the thousand lakes"—together with Sweden and Norway, being the last of the European countries to utilize, to any extent, this class of hydrated ores.

In Canada, for over 100 years, brown hematite iron ores dredged from the bottom of Lac a la Tortue, near Three Rivers, Province of Quebec, were of high repute. The following note thereon, prepared by the writer from data gathered and personal observation made on the spot, appeared in the Annual Summary Report of the Mines Branch, Department of Mines, Ottawa, 1908, p. 19:—

> About 5,000 tons of high grade, brown hematite ore, containing approximately 51 per cent of metallic iron, was dredged out of the bed of Lac-a-laTortue last year. This cake ore—which is deposited yearly—is one of the most remarkable examples of modern iron ore formation. Dredging is undertaken continually for ten years, during which time some 50,000 tons of cake ore is taken from the lake bottom. The pig-iron product of this ore on account of its high tenacity, and non-oxidizing qualities, is used for propeller blade, while the harder grades have been used for over fifty years as the basis of practically all the chilled-iron railway car-wheels made in Canada; the life of wheels made from this metal, surpassing all the best records of the American railways. The metal is also used for chilled rolls, and for this purpose, is shipped regularly to Pittsburgh, and finds a market also in various engineering establishments on the continent of Europe. At the end of every decade, the lake is given a rest of from four to five years. The last rest terminated in 1905.

The natural process by which these unique bog ores are formed is a very interesting modern example of the origin of sedimentary iron ore deposits, hence, a brief description of the phenomenon may not be out of place.

The body of water, known as Lac a la Tortue, or Turtle Lake, is about 4 miles long, by 1¼ miles in average width, and is situated in the middle of a swampy morass. The environing land consists, largely, of sand, doubtless carried from the Archaean rocks in the vicinity by the erosive and grinding action of glaciers.

Standing on the western shore, the spectator gazes in imagination, on a primeval scene. Innumerable streams and rivulets may be seen winding and percolating their way down to the lake, through the sands rich in oxide of iron. These running waters are laden with the decaying vegetable matter which grows rank in the marshy lands, carrying with it quantities of the sand saturated with iron oxide. The organic acids evolved by the decomposition of the vegetable stuff dissolve the oxide of iron, which is carried to the lake. But as it floats down, this solution of protoxide of iron is acted upon by the atmospheric air, oxidation takes place, and a remarkable phenomenon is perceived. Patches of iridescent film appear on the surface of the lake, looking like petroleum with its rainbow colours, indicating that the soluble protoxide has been transformed into insoluble sesquioxide of iron. The reason this peroxide film appears in patches is due to concentrationary action; the particles aggregate themselves into batches, which sink to the

bottom of the lake in the form of cakes, hence the term "cake ore." The ore from Lac a la Tortue is now used in the manufacture of oxide paints.

A notably fallacy with regard to the genesis of lake and bog-ore beds, prevailed among the last generation of writers[1] on ore deposits. Their theory was, that lake iron-ores were largely of bacterial origin: deposited by algae or diatoms, and more particularly by *Gallionella feruginea*, which stores ferric hydroxide in its cells. It has been proven that while certain bacteria do percipitate ferric oxide, the part they play in the formation of the ore beds is infinitesimal. Examination of many lake and bog ore deposits have failed to verify the hypothesis. The modern view is, that the principal agent is humic acid:[2] found in large amount in marshy places. This organic acid combines with ferrous salts to form ferri-humate, which by further decomposition, is transformed into ferric oxide.

The largest deposits of brown hematite in commercial use, to-day, are the "non-bessemer" ores of Lorraine and Meurthe-et-Moselle, France, Luxembourg, Northern Spain, Northamptonshire, Lincolnshire, and Forest of Dean, England, and Appalachian limonite of southeast U.S.A.

Spain.

Of the above-mentioned limonite deposits, those of Bilboa near the shores of the Bay of Biscay in northern Spain, are probably the most important, especially as regards quality. It is true siderite and hematite exist there to a considerable extent, but limonite is of the widest distribution, the highest grade of which —the "Rubio Avenado"—has an average iron content of 50—52 per cent, and is practically devoid of deleterious constituents, for silica is moderate, while phosphorous and sulphur are almost completely absent. The ores are recognized as ideal for Bessemer steel-making purposes, hence have been greatly sought by Great Britain, Germany, and other countries.

In the Bilboa district, within an area of about 15½ miles long and 5 miles wide, it was computed in 1878, that there were 250 million tons of payable ore available. Prior to 1910, over 150,000,000 tons of limonite were shipped, and the output since that date has been at the rate of some 4½ million tons yearly, except during critical periods of the great war. It is estimated that about 50,000,000 tons of the high-grade ore is still available.

Expert investigators aver that the Bilboa deposits present an excellent example of the metasomatic changes of siderite to hematite. In proof, hand-picked specimens taken from the principal beds in the Bay of Biscay district are exhibited, showing a kernel of siderite—the original ore—within an envelope of limonite.

France.

Just before the conclusion of the great war, 1914-1918, a German ironmaster, in addressing a meeting of colleagues charged France with gross selfishness, because, although possessing iron-ore resources of some 10,000,000,000 tons, she inconsiderately refused to give up willingly the French-Lorraine deposits amounting to 3,000,000,000 tons, which would give Germany 6,000,000,000 tons, and still leave France with 7,000,000,000 tons of reserves. The Teutonic estimate of French resources was, of course, purely apocryphal, for the International Geological Congress of 1910 assigned only 3,300,000,000 tons of iron ore reserves, of which 3,000,000,000 were in the "Meurthe-et-Moselle district. When in 1815 and in 1871, France was deprived of the immense iron-bearing district since known as "German-Lorraine," she set to work and explored every nook and corner within her European borders, and in her colonies, in a search for compensating iron ores, but a liberal estimate of final results has given the total reserves as only 2,500,000,000. What the loss to France was when the extensive deposits in eastern Lorraine were wrung from her, may be realized when it is stated that out of the 28.6 million tons of iron ore mined by Germany, in 1913, some 21 million tons were mined in so-called "German"-Lorraine alone.

France is once more in possession of the greatest iron ore areas in central Europe, for the deposits wrenched from the grasp of Germany are 62 miles long by 6 to 12 miles wide, and embrace 2,200,000,000 tons of fine-grained, oolitic, or "Minette" ores. True the iron content of these ores is only 28 to 35 per cent, but owing to the high percentage of lime, they are self-fluxing, hence are more valuable than many ores with a higher metallic content.

The so-called "Minette' ores of France, are of middle Jurassic age, similar to the Jurassic ores of England, which are being exploited so advantageously just now. They are said to be of sedimentary origin. In some districts several of these oolitic ore beds follow one above the other, each of which is remarkably uniform in composition.

At one time these ores were deemed altogether unsuitable for steel making, owing to the high percentage of phosphate of lime they contained. But the problem of the objectionable phosphorous was solved by the epoch making discovery of the young Englishman, Sidney Gilchrist Thomas, in 1877. Up to that date, the high phosphorus iron ores of England, Germany, and the United States were practically useless for the production of steel. By the introduction, however, of a basic lining in the Bessemer converters and open-hearth furnaces, together with the addition of lime to the metallic bath, the phosphorus was practically eliminated, and the steel trade of the great industrial nations revolutionized. Germany, in 1873, produced from her newly acquired Minette deposits, only 809,541 tons, whereas in 1913, by the utilization of the basic process, 21,000,000 tons were utilized, the total production up to 1913 being over 300,000,000 tons. Like progress, due to the same cause was made in the Cleveland district in England and in the Pittsburgh district of the United States.

France, in 1913, mined 21,714,000 tons of iron ore, but now, with the addition of the extensive deposits controlled by Germany during the last 49 years, and from which, as stated, 21,000,000 tons were mined in 1913, the prospects of a great revival in iron and steel industry are auspicious, provided an adequate supply of coal—and particularly coke for smelting purposes—can be obtained. But even possession of the German Saar Valley, with its extensive coal fields will not suffice to meet the fuel deficiencies of the French Republic. It is manifest that success can only be achieved by co-operation with her Belgian and British coal producing allies, and by mutual ar-

---

[1] C. G. Ehrenberg, 1888; W. Mattieu Williams, 1890.

[2] "Ore Deposits," by Beyschlag, Vogt, and Krusch, Vol. II, p. 986-7, 1916.

rangement with Germany, where good coking coal is found in abundance.

England.

In the industrial world, nothing has been mode remarkable recently than the renaissance of British iron-ore mining, which, if continued, will, in the near future, render Great Britain practically independent of foreign supplies of crude steel, for prior to the war, some 2½ million tons of steel—slabs, blooms, and billets—were imported into Great Britain, chiefly from Germany. This revival in mining has been largely due to the exigencies of war times, for by the end of 1916, the greater part of the existing stocks of Bessemer ore had vanished and blast furnaces hitherto dependent on foreign supplies had to be shut down, owing to the submarine menace. Something radical had to be done, hence the British Government, in 1917, appointed a commission of expert mining and metallurgical engineers to study the situation, as to the possibilities of utilizing the untouched iron-ore deposits of the country, increasing the current output of the mines in operation, re-opening disused mines and extracting the pillars therefrom. This was done with characteristic British thoroughness, the result being, that by the end of 1917, the production of iron ore had increased by 1½ million tons, and in 1918, by 2½ millions.

Out of a total of 15,044,373 tons of iron ore mined in the United Kingdom in 1918, 12,252,738 tons consisted of Jurassic ironstones—80 per cent of the total production. These Jurassic ores are almost identical in chemical composition and physical structure with the Minette ores of Lorraine, and as in the case of German and French practice with this class of ores, the pig-iron produced therefrom, could only be converted into steel by utilizing the "Thomas" basic process. This involved a corresponding increase in the demand for refractory materials, such as magnesite bricks needed for the linings of Bessemer converters and open-hearth furnaces, but unfortunately, the magnesite brick industry was practically monopolized by Austria. An adequate supply of magnesite was, therefore, eagerly sought, and fortunately, was found in quantity at Euboca, Greece, and at Madras, India. As to dolomite and limestone, search in Britain itself, disclosed abundant supplies of these essential refractories.

Up to 1917, comparatively little advantage was taken by Great Britain of her immense deposits of lean Jurrasic, brown ores, but the utilization of these hitherto despised ores has been made possible by the erection of new blast furnaces, immense basic steel works and rolling mills, constructed on modern lines—supplemented by roasting kilns, by-product coke ovens, etc., and all located with a view to the economic supply of ore, fuel, and flux. Due to increased supply of iron ore and manufacturing facilities, the export trade of England is going up by leaps and bounds, while the tonnage of shipbuilding (June, 1920) was greater than in any period of British history, namely, 3,578,153 tons—fifteen times more than in March, 1919—the total for all other countries being only 4,142,751 tons.

(To be Continued.)

CANADIAN WELDING SOCIETY FORMED.

At a meeting held in the Prest-O-Lite offices, Toronto, Thursday, December 16th, at which were what may be styled the foremost exponents of the welding industry in Canada, it was unanimously decided to form an organization to be known as "The Canadian Welding Society".

The Society will embrace all processes of welding, including gas, electric and thermit, and all classes of men and companies connected with or interested in the art. Special attention will be given to the spreading of publicity regarding the trade both for the benefit of the general public and the welders themselves.

The Society will endeavor to assist in the general advancement of the trade, to work for co-operation amongst companies, employers and employees, for co-operation with other technical bodies for the advancement not only of the welding trade, but of all other industries in the metal-working line.

That a need for some such organization has been felt was plainly indicated by those present at the meeting, and by the complete unanimity of thought and action.

Joseph N. Robinson, Managing Editor of "The Canadian Welding Journal," was appointed Chairman, and A. A. Stewart, Secretary; these two, with F. Borys, Commercial Manager of L'Air Liquide Society, to form an Executive Committe to carry on until the election of permanent officers and the first general meeting, which will be held early in January.

Those present at the meeting were:

H. E. Mussett, Sales Mgr., Canada Carbide Co., Ltd., Montreal.

A. M. McMillan, Service Dept., Canada Carbide Co., Montreal.

F. C. Hamilton, Manager, Canadian John Wood Mfg. Co., Ltd., Toronto.

J. H. Moore, Editor "Canadian Machinery," Toronto.

J. N. Robinson, Managing Editor, "The Canadian Welding Journal," Toronto.

A. A. Stewart, Secretary, "The Canadian Welding Journal," Toronto.

. . Damp, Manager, Damp Bros., Welding Co., Toronto.

H. R. Swartley, Jr., Vice-Pres., Davis-Bournonville Co., Jersey City.

J. F. Crowley, Ontario Sales Mgr., Davis-Bournonville Co., Toronto.

W. H. Ludington, Eastern Sales Mgr., Davis-Bournonville Co., Montreal.

W. F. Thatcher, Manager, Dominion Oxygen Co., Ltd., Toronto.

F. Borys, Commercial Manager, L'Air Liquide Society, Toronto.

. .McDougall, Engineering Dept., L'Air Liquide Society, Toronto.

R. E. Smithies, Engineering Dept., Lincoln Electric Co. of Canada, Limited, Toronto.

J. H. McDonald, Welder, St. Catharines.

A. J. McDougall, Supt., National Electric Products Ltd., Toronto.

. . Skelly, Secretary, National Electric Products Ltd., Toronto.

R. H. Combs, Gen. Mgr., Prest-O-Lite Co. of Canada Ltd., Toronto.

. . Montgomery, Sales Mgr., Prest-O-Lite Co. of Canada Ltd., Toronto.

A. M. Barry, Manager, St. Lawrence Welding Co. Ltd., Montreal.

COMPANY NOTES

Steel Plants on Reduced Operations.

All the primary steel plants in Canada are operating on a reduced scale of production, or are temporarily closed down.

The Dominion Iron & Steel Company's plant has one blast furnace in operation, and is finishing up some small orders at the Plate Mill. A so-called embargo on freight shipments from this Company's plant at Sydney has been attempted by the employees of the Canadian National Railway, who are acting in this manner in support of certain railway employees of the Steel Plant who belong to the railway brotherhoods. Less that half the usual number of men is being employed at this plant, but the slackness is due to trade conditions, and not to the action of the railway men.

The Sydney Mines steel plant remains closed. Work is proceeding as usual at New Glasgow, but a curtailment of employment is anticipated there shortly. The Car Works has sufficient orders to keep the men busy until the end of February, and a full staff of men is employed at the present time.

The Steel Company of Canada at Hamilton, and the Algoma Steel Company at Sault Ste. Marie, are only operating the finishing departments, and are not making pig-iron or steel.

A number of smaller companies have announced suspension of operations and readjustment of wage schedules. The Maritime Nail Company, of St. John, N.B., has closed its works, employing 200 men, and has intimated that the works will reopen when the men will accept a rate of wages that will enable the Company to sell its product without loss.

The Billings & Spencer Foundry at Welland has suspended operations, and the Company has posted notices that all employees, including salaried men are free to seek employment elsewhere.

It is understood the works of the Maritime Bridge Co., at New Glasgow, a subsidiary of the Dominion Bridge Co., which were destroyed by fire in the Summer, will not be rebuilt at New Glasgow.

The Standard Steel Construction Co., with plant at Port Robinson, have transferred their head office to Welland. The company during the war operated a munitions plant at Port Robinson and have been gradually disposing of machinery that is not required in their regular line of manufacture.

The buildings, plant and equipment of the Electro Foundries Limited, at Orillia, were totally destroyed by fire on Dec. 5th. The concern was electrically operated, smelting being done with an electric furnace of 1,500 K.V.A. capacity. Ferro-silicon and pig iron were the products, and the foundry was being operated continuously day and night. The loss will be from $25,000 to $40,000, depending upon the condition of transfomers and other electrical equipment after the fire. The plant was insured. The Canadian Castings, Limited, which is operated in an adjoining building, was undamaged.

Mr. Stanley Elkin, M.P., Director of the Dominion Steel Corporation, and President of the Maritime Nail Company at St. John's, N.B., has been appointed Director of Sales for the Corporation. Mr. Roy McKeen, who has been in the Sales Department of the Steel Company at Sydney for many years, and is the Assistant General Sales Agent, has been moved to the Montreal office to take up the work of the late General Sales Agent, Mr. J. P. McNaughton.

Mr. Roy M. Wolvin, Prsident of the Dominion Steel Corporation is in London on business connected with the British Empire Steel Corporation propsals. Mr. D. H. McDougall, President of the Nova Scotia Steel Company is in London in connection with the same matter.

CANADIAN CAR AND FOUNDRY COMPANY'S REPORT.

The net profits of the Canadian Car & Foundry Company for its fiscal year 1920 were $539.397, compared with $1,887,635 in 1919, and $3,964,172 in 1918, after deduction in each instance of fixed interest charges and depreciation. The regular dividend on the Company's preferred stock called for $525,000, but an additional payment of 1¾ per cent was made on arrears of dividends, so that actual dividend payments were $117,000 in excess of net profits. The surplus stands at $6,243,603, compared with $7,081,557 at the close of 1919.

The balance sheet shows a doubling of inventories, from $7,394,226 in 1919 to $14,788,960, which was caused by accumulations of material arising from protracted railway delays. Working capital is $8,500,581, compared with $10,363,975 in 1919.

The president, Mr. W. W. Butler, said with regard to the future of the Company's operations:—

> "The value of the orders unfilled at the termination of the year amounted to approximately $26,000,000, as compared with approximately $8,500,000 at the close of the preceding year. This large amount of unfilled business practically makes certain a steady output for some time ahead, and taking into consideration improved labor conditions and the fact that the bulk of the materials necessary is now on hand, your directors are hopeful that the results for the ensuing year will prove satisfactory. The outlook for future business is encouraging. Although financial conditions may delay the placing of orders, there is admittedly a serious shortage of equipment on Canadian railways, and your directors are not neglecting export possibilities."

DOMINION BRIDGE COMPANY'S ANNUAL STATEMENT.

The Report of the Directors of the Dominion Bridge Company for the year ended 31st October, 1920 shows net earnings for 1920 of $964,530 compared with $1,343,305 in 1919. With the amount of $444,530 carried forward from the 1920 earnings, after payment of common dividend of $520.000, the surplus is increased to $4,293,143, comparing with $3,848,813 at the end of the previous year. The working capital shows increases in current assets, and reduction in current liabilities, and stands at $5,127,955, compared with $3,867,406 in the last annual statement. Bank loans and mortgages have been paid off, and the reserve account shows a substantial increase. The balance sheet shows a strong financial position, with liquid assets and no liabilities on capital issues except the common stock of $6,500,000. The assets of the Company stand at $12,848,960.

The Report states:—

"The volume of business booked during the year under review has not been up to the average and your plants at Lachine. Toronto and Ottawa have run at less than normal capacity. It is gratifying, however, to state that the Winnipeg plant has carried out the most satisfactory program since that branch was opened.

"The expected reduction in value of materials is now taking place and your inventories have been figured with this fact in view. Investments in other companies and in fixed assets are conservatively rated.

The liquidation of the St. Lawrence Bridge Company was completed during the year. Your capital invested in that company has been returned and dividends to the amount of $265,797.50, which are included in the profits for the year, were also received.

"The Dominion Copper Products Company, Limited, in which your Company holds the controlling interest, has sold its plant and equipment to a new Company. The land and buildings used by Dominion Copper Products Company, but which belonged to your company, have also been sold. The price received for the land and buildings has been applied to the reduction of fixed assets and the affairs of the Dominion Copper Products Company, Limited, are now being liquidated.

"A special meeting of shareholders authorized the transfer of the Dominion Engineering & Machinery Company, of which your company held all the shares, as a going concern to the Dominion Engineering Works, Limited, for the controlling interests in the shares of the latter company. The plant of the Dominion Engineering Works is now being enlarged in accordance with the circular to enable it to manufacture the largest type of water wheels and it now has on its books orders for a number of very large wheels, in addition to paper-making machinery.

"The Robb Engineering Works of America, in which your company has a controlling share interest, had, before your company acquired its interests, arranged to develop a farm tractor for the purpose of using its surplus manufacturing facilities. The experiments with this tractor were so successful and met with so much favor in the West that your directors considered it advisable to proceed with production on a manufacturing basis. The Robb Engineering Works, however, was not in a position to market this tractor, the principal field of sale being in the Prairie Provinces, and for this purpose your directors incorporated the Canadian Tillsoil Farm Motors, Limited, with a share capital of $50,000 8 per cent cumulative preferred shares and 10,000 common shares of no par value, all of which shares are owned by your company."

TELFORD GOLD MEDAL MERITED BY Mr. G. H. DUGGAN.

In announceng th awards for papers published without discussion in the Transactions of 1917-18, the Council of the Institution of Civil Engineers (Great Britain) state that a paper by Mr. G. H. Duggan, PPresident of the Dominion Bridge Company, had merited the award of a Telford Gold Medal, but the author being a member of the Council of the Institution, is by rule ineligible to receive a medal.

NEW DEVICE FOR TESTING VARYING HARDNESS OF MICRO-CRYSTALS OF METALS AND ALLOYS.

"Iron Age" of 30th December contains an illustrated description of a new device of exquisite fineness which permits the testing, by a cutting impression of a sapphire point, of the varying hardness of the individual crystals of metals and alloys under microscopic examination. The instrument is described in the porgress report of a sub-committee of the American Society of Mechanical Engineers on bearing metals. The varying hardness of the crystals in bearing alloys, and consequent varying relief under pressure, is a well-known phenomena, to which some of the properties of bearing metals are attributed, and experiments are described which throw new light on this peculiarity of bearing alloys.

The new instrument provides a point of sufficient hardness to scratch martensite crystals in hardened tool steel, of such fineness as to represent a refinement of at least one thousand fold over the finest cambric needle, sharps No. 12. The application of the point is made through a jewelled balance, and it is stated that a three-gram weight is the lightest which will make an impression on the hardest of the crystals which it is desired to investigate. The sub-Committee also submitted with its report a diagrammatic scale of micro-hardness, expressing the relation of the hardness of different materials in definite units worked out as a result of the investigation.

The Committe comprised C. H. Bierbaum, Vice-President of the Lumen Bearing Co., Buffalo, Chairman; J. E. Capp, testing laboratories, General Electric Co., and Prof. H. Diederichs, of Cornell University.

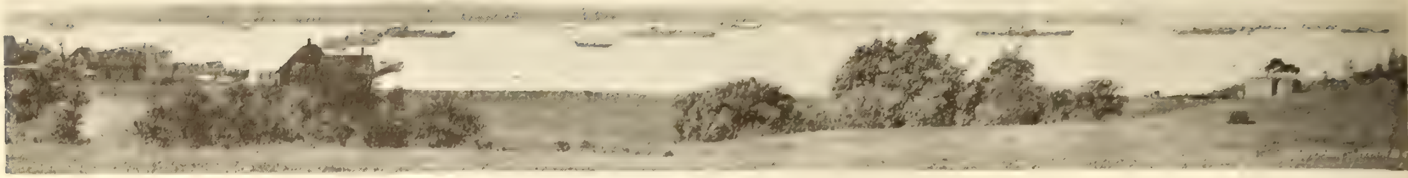
The report marks a distinct advance in the instruments available for the use of the metallographist.

YAMPI SOUND IRON DEPOSITS, QUEENSLAND.

We have received from the General Manager of the State Iron & Steel Works, operated by the Department of Mines of Queensland, Australia, some particulars of the Yampi Sound iron deposits. Yampi Sound is situated in the north-west coast of Australia, and the iron deposits are found on two islands, just off the mainland, known as Kooland and Cockatoo Islands. The Koolan Island deposit is estimated to contain about 40 million tons on the surface, and Cockatoo Island about 13 million tons, and as there is said to be no reason why the deposit should not continue in depth for at least 100 feet below sea-level, the probable available tonnage is much greater. The Cockatoo Island deposit has been purchased outright by the Government of Queensland, who intend using the ore to mix with ores from other parts of North Queensland, some of which are slightly high in silica, for use in the State Iron and Steel Works.

Analysis of cores from the borings shows following composition of the ore:

Iron	69.6%
Silica	·1
Manganese	—
Phosphorous	·01
Sulphur	·005
Alumina	·1
Magnesia and Lime	None



SHIPBUILDING

Halifax Shipyards, Ltd.

The annual meeting of Halifax Shipyards, Ltd., was held on December 15th, when the President was able to record a year of satisfactory business and profitable returns, and in contrast to many other shipbuilding yards in Canada and elsewhere, the outlook for the plant was stated to be hopeful.

In addition to the completion of two standard ships for the Government during 1920, two other ships of 10,500 tons capacity are under construction, and delivery is expected to be made in June of this year.

The President stated that contracts for five large oil tankers were virtually consummated, which would ensure the immediate future of the Plant. Two thousand workmen were employed, and Mr. Smith said he regarded the future of the enterprise with optimism.

In addition to the construction of new vessels much general work had been done, and this branch of work is a fairly permanent asset of a plant situated at Halifax.

Dominion Shipbuilding Company, Toronto.

After the two ships are completed for the Government at the Dominion Shipbuilding plant in Toronto, it is probable that the plant will be put on the market and sold for a machine shop, street car property or some other use, according to the liquidator for the company. The plant, which is a modern one, has been placed in the hands of Joseph Day, 67 Liberty Street, New York agent for industrial sites but nothing can be done until the two boats are gotten out of the way. Mr. Wade stated that the Collingwood Shipbuilding Co. has undertaken to finish this work but has not taken over the yards permanently. It will take approximately five months to finish the ships and about 1,000 will be employed soon and men are being taken on now. The total liabilities of the company are $1,134,000, of which $204,000 are preferred claims. The assets are $2,691,000, leaving a surplus of $1,557,000.

British Columbia Yards During 1920.

Steel Shipbuilding on the British Columbia coast shows a larger deadweight tonnage of production for 1920 than for the preceding year. This in spite of the frequently repeated statement that shipbuilding was going backwards. The credit for the good showing of the Coast yards can be laid directly to the shipbuilding firm of J. Coughlan & Sons, Limited, of Vancouver, which continued building when Government contracts failed and successfully carried out the proposition of building to yard order for the world markets, and also to build for its own service.

In 1919 there were 70,200 deadweight tons of steel vessels built by the British Columbia Coast yards, construction being entirely in Greater Vancouver plants. The ships were all for either the Imperial Munitions Board or the Dominion Government.

In 1920 the total is 83,300 steel tons, consisting of freighters for the G.G.M.M., Limited, one coasting vessel for the Union Steamship Co., of B.C., and five freighters to the private order of the Coughlan yards, either for sale later or for their own operation. They built and sold the steamers Braheholm and Indus, built and are now operating the steamers Margaret Coughlan, City of Vancouver and City of Victoria, and built the G.G.M.M. steamers Canadian Inventor and Canadian Prospector.

They will start work on two more ships for the Canadian Government on the first of the next year.

The Wallace Shipyards built two vessels, the SS. Canadian Highlander and the steamer Chilkoot. They are now building the steamer Canadian Skirmisher. She will be launched in January.

At Victoria the Harbor Marine Shipyards built two G.G.M.M. steamers the Canadian Winner and the Canadian Traveller. In addition one wooden ship, the S. F. Tolmie, was launched at the Cholberg Shipyards Tuesday. No vessels were launched at the Prince Rupert yards.

Following is the list of launching for the year:—

	Deadweight tons.
Jan. 24—Canadian Inventor	8,100
Feb. 24—Canadian Prospector	8,100
Feb. 26—Chilkoot	800
Mar. 25—Braheholm	8,800
May 18—Margaret Coughlan	8,800
June 30—Indus	8,800
June 29—Canadian Winner	8,100
Sept. 10—City of Vancouver	8,100
Sept. 24—Canadian Traveller	8,100
Oct. 28—City of Victoria	8,800
Dec. 20—S. F. Tolmie	3,200
Total	88,500

By Yards—

J. Coughlan & Sons, Ltd. (steel)	60,200
Wallace Shipyards (steel)	8,900
Harbor Marine, Victoria (steel)	16,200
Cholberg, Victoria (wood)	3,200
Total	88,500

Prince Rupert Drydock and Shipbuilding Co.

A meeting of the creditors of this Company was held at Prince Rupert on the 6th January, which disclosed liabilities to creditors of $800,000. The local member for Prince Rupert is endeavoring to have the Government complete the unfinished vessels so as to provide employment for the workers, but so far no definite announcement has been made as to the Government's course of action, or the status of the Guarantee Company in the matter.

Esquimalt Dockyard.

The contract for the construction of the Esquimalt Dockyard has been let to P. Lyall & Sons, of Montreal. It is stated the accepted tender totalled $4,300,000.

Correspondence

The Bonusing of Iron-Ore Mining in Ontario.

Editor, Iron and Steel of Canada,

Port Arthur, Ont., December 11th, 1920.

Sir:—

In your issue of December 3rd, 1920, there was an article by Mr. J. J. O'Connor commenting favorably on the Conference of members of the Port Arthur and Fort William Boards of Trade, and the Hon. Harry Mills, Minister of Mines, on November 27th.

As the writer was one of the delegates mentioned, I would like to take up the reasons which called for this Conference, and the procedure advocated by the Minister of Mines for the development of the iron resources of Northern Ontario.

About a week before this Conference was called, the Minister of Mines, in an address to the Convention of the Municipalities held in Fort William, made the statement that he did not think a bonus was the most efficient plan for the working out of the problem. In his opinion electric smelting was a solution of the treatment of our low-grade iron ores. Electrical power at $10.00 or $12.00 H.P. per annum would, he claimed, compete with coal at present prices, and this procedure would really be the more efficient plan for the problem in hand. When asked where the $10.00 or $12.00 power was to come from, Mr. Mills was at a loss for an answer to the question, and apparently did not care to enter into any discussion on the matter.

When the Board of Trade delegates met him, he stated that while as Minister of Mines he would not advise against a bonus, his personal opinion was strongly aginst the granting of a bonus in any form, and he thought some other plan could be worked out that would be more efficient and more permanent than a bonus of iron ores for a more or less extended term of years. The writer asked if he was referring to electrical smelting as mentioned in his address at the Conference. I also pointed out that in a conference with American engineers in 1914, I took up the question of electrical smelting with these men, who were responsible consulting engineers for large iron companies. Their reply was a question, "What is power worth in Canada?" As Quebec then had the cheapest power in the Dominion I gave them $12.00 as being about the average cost of production in that Province. Their summing up was as follows:—When you can produce power at this time for $4.00 instead of $12.00, then you can consider electrical furnaces as an active factor in competition. With care I repeated this opinion to Mr. Mills, pointing out that our foremost experts declare we would want power at one-third the actual cost of production at any time, to compete with the present-day smelters.

That ended the discussion as far as electrical smelting was concerned.

The Minister then stated that he had what he considered the most efficient plan for the solution of the problem: that is a re-survey of, diamond-drilling and testing of all our iron ranges, this work to be carried on by a commission of experts who would teach us how to **mine, diamond drill, smelt, treat, refine** and **market** our ores. When the storm of commendation had passed over, one of the delegates from the Fort William Board of Trade, who had introduced himself as an engineer with practical experience in furnaces, made the suggestion that the Minister go even farther with his program, that markets should be established so that the farmer could market his ton of ore at the same time he brought in his load of wood, or a few sacks of potatoes. As the Zulus in Central Africa and the natives in the interior of India still carry their ores to the furnaces in baskets and rolls of matting, this gentleman showed that he, at least, was in favour of being progressive. I endeavoured to point out to the Minister that a survey such as he suggested would take twenty-five years to complete, and at the end of that time we would be standing exactly where we are now, but my comment was ridiculed, and the Conference was ended at that point, after the Minister being assured by the Presidents that he would have the solid backing of the Boards of Trade of both Cities.

In defense of my statement, I would like to point out just what tedious operations such surveys, drilling operations, and testing of various ores really amounts to. In 1901, I had charge of a section of the large exploring party, organized by the well known consulting engineers, Prof. Pumpelly and Prof. Smyth. This work was carried on by these men in the seasons of 1901 and 1902, and operations were confined to limited distance of Lake shipping in the Thunder Bay and the Rainy River Districts. On my section of the party I had two expert cruisers, and our work during the season of 1901 was confined to the examination of about six square miles of territory. This occupied the whole season from the latter part of May, to the middle of October. This was a mere preliminary examination, to decide whether the iron range explored was worth acquiring from the Crown, or otherwise. No detail work was done at all and it was estimated at the time that the five square miles which were surveyed and purchased from the Crown, would take an engineer and three cruisers approximately five months to work out the details of the survey before making plans for diamond drilling. Lest we be accused of not being among the live men mentioned by your correspondent, I might mention that Messrs. Pumpelly and Smyth gave their entire approval to the method in which the work was being carried on and they still take my reports at par.

The United States Steel Corporation spent nearly two years in diamond drilling on the Atikokan Iron Range, and several months additional in the mining and treating of large-scale roasting tests.

J. D. Gilchrist of Denver, Colorado, spent the whole

of the summer seasons of 1918 and 1919 in examinations and taking out samples varying from 100 to 1000 pounds for concentration tests of our low-grade ores. After spending the winter months of the same years on the working out of these tests on a laboratory scale, he advised me that he had found three ranges which he **hoped** could be treated with the one type of concentration plant, but he could not be sure of this until a suitable pilot plant had been erected and a commercial size test had been obtained.

Dwight Woodbridge, who was the founder of a testing plant in Duluth, Minnesota, had practically unlimited capital, expert help of every description, and the entire confidence of the Hayden Stone Company who had spent a quarter of a century in working out the problem of concentrating low-grade ores. Yet, over three years in time was taken up, and the plant had to be remodelled a number of times to devise the best method of concentrating the low-grade ores on one range alone.

As I have mentioned in a former letter to your paper, I have visited personally over 1000 lineal miles of iron ranges in Northern Ontario, all within shipping distance of Lake ports; of this 1000 miles I considered that there were at least 100 miles which were worthy of the close detailed survey that would precede any plan of diamond drilling. The performance of all this work mentioned should give the variest layman some little idea of the problem ahead of the Minister of Mines in carrying out his suggestions. As we have admittedly no visible ore-bodies of high-grade ore between the boundaries of Manitoba and Quebec but what need beneficiation in some form, beneficiation would seem to be our principal problem. (This does not mean that no high-grade ore bodies would be found on these ranges, on the contrary I am firmly of the opinion that merchantable grades of ore will be found, but the search for these will necessarily be costly and may take years to carry out.) Therefore, as I have estimated we have within a radius of 100 miles of the Twin Ports at least 300,000,000 tons of ore which might be concentrated commercially by some method or other. I would consider that if the Minister of Mines carries out his plan and teaches us how to mine, diamond drill, treat, market, etc., the ores in all this territory, of course erecting pilot plants as needed for the concentration tests of these ores, that when I mention twenty-five years as the time limit needed, I might still be a year or two under the mark.

As we have in the Thunder Bay District greatly diversified types of low-grade ores, the problem of concentration or other forms of beneficiation must be worked out by the operators on practically each range individually, and it is our opinion, and the opinion of the majority of our Canadian engineers, that a reasonable bonus, given over an extended term of years, would be the most attractive inducement to investors and producers of iron ores.

A direct vindication of the request of the Mining Committees of Northern Ontario for a bonus, is the mooted establishment of a 15,000,000 dollar steel plant in the Province of British Columbia. This has been undertaken after a careful survey of the situation by Mr. Sloan, the Minister of Mines; and it was owing solely to his recommendation and indefatigable efforts that the project for the establishing of a large iron and steel industry, in what is really a somewhat isolated Province in that respect, has taken definite shape. Owing to this isolation it was deemed a better plan to have this bonus given to the producer of pig iron, as he must necessarily equip steel works to use up his own product.

The problem for the Provinces of Manitoba, Saskatchewan, Alberta, and the North Western Territories could be worked out on somewhat similar lines. Sault Ste. Marie markets heavy iron and steel at Pittsburg prices, plus the duty. Duluth steel plants market their product at Pittsburg prices, plus the freight from eastern plants. All heavy iron and steel landed at the Twin Ports of Port Arthur and Fort William cost approximately 8 p.c. of purchase price from Sault Ste. Marie or Duluth, and over 20 p.c. from the eastern steel plants for freight alone. It is also admitted by the United States purchasers of heavy iron and steel that Duluth can manufacture practically at the same cost as Pittsburg. Let the Western Provinces combine in giving a bonus of from 3 to 3½ p.c. on actual capital invested, extending over a term of from 20 to 30 years to aid in the establishment of steel plants where iron, coal and power meet, at the Canadian Head of the Great Lakes. These plants could be bound to sell to the Western Provinces at Duluth prices, minus the freight from eastern plants to the Head of the Lakes, thus effecting a saving of from 8 to 20 p.c. Assembling and finishing plants could be erected at various points in the west to further cut down the westerly freight in all directions, in threshing outfits, farm implements, etc., and the districts where this material is marketed would also be greatly benefitted. The Provincial Government of Ontario and the Federal Government could combine in giving a reasonable bounty on iron ore, extending over a term of at least 15 years payable strictly to the operator of the mine. Do this and the annual import of nearly $200,000,000 worth of iron and steel products from the United States will dwindle more rapidly than did the production of iron ore in Ontario, and Tariff critics in the western Provinces will have less to complain of in defense of the claims of the agriculturist.

J. E. MARKS.

STUDY OF LOW-GRADE IRON-ORES IN THE UNITED STATES.

The annual report from the United States Bureau of Mines relates the progress made at the Minneapolis Experiment Station in the study of low-grade iron-ores, which is being conducted by D. A. Lyon, the Chief Metallurgist. These experiments are of much interest in Canada, particularly the investigations into beneficiation of low-grade ores, and the production of sponge iron.

"The United States," says the report, "has extensive deposits of low-grade iron ores that cannot be smelted profitably under present methods. If these low-grade iron ores. This work has been done under the country would be enormously increased, but in order to obtain the iron, enough of the gangue and impurities in the ore must be removed to raise the iron content to the percentage required for profitable smelting, or else methods of smelting ore of lower iron content must be devised.

"The Bureau's work on iron is centered at the Minneapolis station, and is being conducted in co operation with the School of Mines, University of Minnesota, and with the State mining experiment station.

"The State experiment station and the mining companies have done and are doing much work on the development of methods for concentrating and washing low-grade minable ores, and for eliminating objectionable impurities, such as phosphorus and sulphur, to bring the ore up to commercial grade. The Minneapolis station is co-operating with the State mining experiment station in beneficiation tests of samples of low-grade iron ores, collected from dumps and stock piles by mining engineers of the station in their study on mining equipment and concentration methods employed by the iron ranges.

"The Bureau of Mines, however, is paying attention rather to the second phase of the problem, namely the devising of practical methods for reducing ore which is considered too low-grade for blast-furnace smelting in present practice.

"During the year an experiment blast-furnace was erected at the Minneapolis station, and tests are under way on possible methods of smelting low-grade manganese ores. This work has the further object of obtaining a comprehensive record of furnace data, and will be extended to include a general study of the operation of iron blast furnaces.

"An investigation of the methods for determining phosphorus in iron ore was made at the Minneapolis station and a report prepared on the subject. Experimental work to determine the feasibility of removal of phosphorus from iron ores by leaching showed that the method is not commercially practicable.

"The Minneapolis station, preparatory to a study of heat treatment of drill steels, is collecting samples and making preliminary metallographic tests.

"Work at the Berkeley, Cal., station on an investigation of methods of producing sponge iron continued throughout the year.

"The Golden, Col., station, in co-operation with the Primos Chemical Co., Primrose, Pa., and with the Colorado School of Mines, is studying the preparation, properties and uses of molybdenum steels with the object of arriving at the best conditions under which duplication of steels of definite composition can be obtained. The work is under the direction of R. Keeney, of the Colorado School of Mines."

DOMINION IRON & STEEL CO. REDUCES WAGES.

The Dominion Iron & Steel Company has posted the following announcement of a reduction in wages:

"Effective on and after January 17, 1921, there "will be a reduction of twenty per cent. (20%) in "the wages of all the employees of the Company.

"The demand for Pig Iron and Steel Products has "fallen off to such an extent that the Company may "be compelled to close down its Plant and the above "reduction in wages is made with the hope that the "Company may obtain sufficient orders to give "employment to some, it not all, of its employees."

LARGE ELECTRIC SHOVEL IN LIMESTONE QUARRY.

The "General Electric Review" for December 1920 contains a detailed description of the use of 300-ton electric shovels in open-cut limestone quarrying in Michigan, where it is proposed to handle 5,000 tons of limestone daily with each shovel.

Shock Test in Engineering and Steel Work's Practice

By Colonel DAVID CARNEGIE, M. Inst. C.E., F.R.S., Edin.

During the month of December, 1920, three very important communications have been made to the Institution of Civil Engineers, London, on the subject of Shock Tests and the Standardization in Engineering Practice. Dr. Thomas E. Stanton and Mr. Reginald G. C. Batson have recorded an extensive series of tests carried out principally at the National Physical Laboratory, London. Messrs. Richard H. Greaves and Harold Moore have given the results of a series of experiments conducted at the Research Department, Woolwich Arsenal, and on the 14th December, 1920, the last contribution was made by Sir Robert Hadfield and Mr. Sidney A. Main, which was the result of experiments in the Research Laboratory at Messrs. Hadfield's, Ltd., Sheffield.

These contributions have added considerably to our knowledge of shock tests and their value in engineering. Although impact tests have been recognized for the past twenty years as being of value in the detection of brittleness in some classes of steel, their standardization for general use in the acceptance of all classes of steels have not been established.

Dr. Stanton and Mr. Batson refer to the early work of Mr. Barba, of Le Cruesot, in 1900, revealing differences of behaviour in materials, as regards their resistance to sudden shock when in the notched condition, which could not be detected by the ordinary tensile tests. Mr. Barba's findings were taken up by other investigators, particularly Le Chatelier, Fremont and Charpy, and the results of their researches were communicated to the Congress of the International Association for Testing Materials at Buda Pesth in 1901. That Congress appointed a committee to go into the matter thoroughly and report to the next congress. In 1906, at the congress held in Brussels, a long discussion on the subjecct resulted in the failure to define the experimental conditions to be adopted for notched bar tests. The German Association for Method of Testing Materials appointed a committee in 1906, with Dr. Ehrensberger, of Essen, as chairman, and in 1907 adopted as a result the Charpy method of testing. At the Congress at Copenhagen in 1909, the Germans finally approved of a set of rules as to the sizes of test pieces. A further committee was appointed by the 1909 congress to study the results brought out by the tests. At the congress held in New York in 1912 the committee's report was considered, and it was suggested that further research on testing apparatus be made and on the comparison of the results obtained from specimens of different sizes. Later the Sectional Committee of the British Engineering Standards Committee took the matter up in relation to dealing with tests for materials used in the construction of ships. The National Physical Laboratory undertook a series of tests on notched bars. This was not by any means the first work done in Britain in regard to impact tests. Since 1905 notched bar testing for the engineering public had been done at the National Physical Laboratory and in fact while continental investigators were at work, British research went on

concurrently. At Hadfield's, Ltd., Sheffield, the Fremont shock-testing machine and other shock-testing methods have been used for nearly 20 years in connection with the testing of their steel and other products. Yet, in spite of Sir Robert Hadfield's personal researches and his extended knowledge of perhaps every form of testing of materials, coming under this heading, he states:—

"It will be agreed that shock testing has not been carried out on an altogether satisfactory basis. Several types of machines are used, each with its particular speed of impact, pattern of specimen, form of notch, and scale of toughness. The maximum angle of bend also differs in the different machines."

This fairly, and I think accurately, sums up the present position of shock testing. Around each of these subjects, viz:—

(1) Types of machines used,

(2) Velocity of impacts,

(3) Dimensions of test pieces and form of notches. controversy, research and development have continued without interruption during the past 20 years. If we consider these subjects we find (1) The principal types of machines used are the Fremont, Charpy, Izod, and Guillery.

Speaking of the Izod machine, which is largely used in England, Sir Robert Hadfield says that this machine "continues to serve a useful purpose in specification tests for controlling the quality of certain classes of steel. On the other hand, the type of machine evolved from specification tests is not necessarily the right type for general use, or for standardization." In the Izod machine the specimen is held in a vice at one end and struck by a falling pendulum at the other. The types of machines used in the experiments conducted by Messrs. Greaves and Moore were:—

1. The 60 kilogram-metre Guillery machine.
2. The 30 kilogram-metre Charpy machine.
3. The 120-foot-lb. Izod machine.
4. The 23-foot-lb. Izod machine.

In regard to their conclusions as to the value of different machines they state:—

"For heat-treated nickel-chromium steels the energy absorbed by test-pieces of identical form in the 120-foot-lb. Izod, Guillery and Charpy machines has been found, with few exceptions to be practically identical." "The 23-foot-lb. Izod machines apparently gives less regular results than machines of greater power, taking a larger test-piece."

It is well to notice that these comparative trials were made with hardened and tempered steels and not of steels used for ordinary commercial purposes.

The experiments by Dr. Stanton and Mr. Batson were carried out on the method of test adopted by Mr. Charpy, in which the specimen rests on two supports in a horizontal position and is struck in the centre by a swinging pendulum. The machine was arranged specially so that the anvil could be attached rigidly to a support as in the original Charpy machine, or it could swing. It was so designed that the range of striking speed could be varied from 9 to 43 feet per second.

(2.) With reference to the controversy as to the effect of the velocity of impact in determining relative values of materials from the energy absorbed in the fracture of notched bars by any of the testing methods in use and the corresponding work done in the slow testing to destruction of similar specimens under a gradually increasing load in an ordinary testing machine, Dr. Stanton and Mr. Batson conclude from the recent experiments that, "The results of the investigations on the dimensional and velocity effects in notched bar testing, described in the present paper, indicate the existence of what may be called a "Scale Speed" factor in the law of resistance of notched specimens to sudden shock, which appears to be of extreme complexity. It is possible that further investigation may determine the form of this factor and that the resistance of a piece of material to sudden shock may be defined in terms of its form and dimensions, the velocity of the blow, and some mechanical constants of the material."

Sir Robert Hadfield and Mr. Main says that "with such diversity of the velocity characteristics of existing machines, general agreement between them is not possible over any extended range of materials, purely on questions of velocity-effect. The question naturally arises—seeing that the relative toughness of different materials depends on the velocity at which they are tested, what is the proper velocity to adopt in a standardized method? There seems to be only one answer, namely, that it would be wrong to adopt any particular velocity, and that for an intelligible comparison of different materials a curve is wanted showing the variation in strength for each material with variation in velocity."

Messrs. Greaves and Moore, speaking of their experiments, say that the results obtained are in agreement with those of other workers in showing that, while the velocity of blow, or, more strictly, the rate of increase of stress during the test, is not without influence, the main characteristic of the test is the localization of stress by the presence of the notch, and that the test becomes less discriminating as the sharpness of the notch is diminished.

From the foregoing it is clear that complexity and uncertainty exist as to the value of establishing any standard of velocities in impact methods of testing steels, which would represent relatively the toughness of one steel to another.

3. Dimensions of test pieces and form of notches in impact testing are still subjects of controversy. At the Copenhagen Congress in 1909 a test piece 30 x 30 x 160 millimetres was adopted as a standard, with an alternative of a 10 x 10 x 53 1-3 millimetre specimen when one of the larger dimensions could not be obtained. In 1916 a panel of the Engineering Standards Committee was appointed to consider the relative superiority of the different forms of notches commonly used for 10 x 10 millimetres notched-bar specimens in this country and in Europe. The adoption of the notched-bar tests as an acceptance test in specifications of war material by the Ministry of Munitions led to the urgent demand for some standard which could be relied upon. The Charpy form of specimen known as the 10 x 10 millimetre size was recommended by the International Association of testing materials but the extensive use of alloy steel made it a very costly matter to produce this form of test piece owing to the difficulty in drilling the hole 4-3 millimetre diameter through such steel without skilled labour. The 10 x 10 millimetre specimen, with a 45 deg. V notch having a radius of 0.25 millimetres at the bottom, developed by the Aeronautical

Inspection Directorate during the war was found to be equally effective in the detection of faulty heat treatment as the Charpy specimen and the Sectional Committee on notched-bar tests recommended this specimen as the standard in British engineering practice.

Dr. Stanton and Mr. Batson's investigations now recorded were undertaken subsequent to the conclusion of the standardization of the 10 x 10 millimetre specimen with the shallow V notch, known more commonly as the Izod V-notch. Their investigations regarding dimensions of specimen and forms of notches included a range from 5 x 5 x 26 2-3 millimetre to 63 x 63 x 336 millimetres, in all, five different sizes. The tests were prepared from four different materials. Two different steels, each containing 0.19 per cent carbon, one steel containing 0.48 per cent carbon and one from Yorkshire iron.

Two forms of specimens were used, the shallow-notch form, provisionally standardized by the committee, and the Charpy. I have already referred to the conclusion of the authors as to the "dimensional and velocity and effects in notched-bar testing" under par (2) and I need not here repeat, but would refer readers to the full results of the experiments which have led the authors' to their conclusion.

In regard to the adoption of the V-notch by the Standardization Committee, Sir Robert Hadfield and Mr. Main say that "the selection of the Izod V-notch by the Committee for Standardization seems for many purposes, though not for all, a sound policy in the present state of knowledge."

Messrs Greaves and Moore state in their conclusions that "the form of test-piece now specified by the British Engineering Standards Association (Report No. 131, 1920) appears to be most satisfactory as regards discrimination between tough and brittle material, uniformity of results, and ease of machining."

I don't think there is any doubt that the standardization of the shallow V-notch specimen is a step in the right direction.

Those who were closest to the troubles between manufacturers and inspectors in Canada during the war, in regard to the acceptance of steel, know something about the need for simpler, more economical and more reliable forms of testing materials, and also for the training of men who have the responsibility of accepting materials on the results of tests. If I judge aright of the present progress made in the shock-testing of materials, there is no doubt whatever that such forms of tests are valuable in detecting faults in some classes of overheated and imperfectly treated steels where the ordinary tensile tests fail; but to attempt to replace tensile tests with shock tests for the acceptance of normal materials in engineering practice would be a dangerous mistake.

ANNUAL MEETING OF THE C. I. M. & METALLURGY.

The 23rd Annual Meeting of the Canadian Institute of Mining & Metallurgy will be held in the Chateau Laurier, Ottawa, on March 2nd., 3rd. and 4th. The papers will include communications regarding the iron and steel industry in Canada, and one of the sessions will be devoted to papers and discussion on this topic.

RETIREMENT OF THE DIRECTOR OF MINES AT OTTAWA.

It is announced from Ottawa that Dr. Eugene Haanel, who has been director of the Mines Branch since 1907, when that department was first constituted, has retired in compliance with the regulations of the Superannuation Act. Previous to appointment to the position of Director, Dr. Haanel was Superintendent of Mines in the Department of the Interior, from 1901 to 1907. Dr. Haanel, during his incumbency, took much interest in the application of electricity to the reduction of iron ores. Interest in electric smelting of ferrous metals in America may be said to date from the time of the Canadian Commission's tour in Europe in 1904, and the historical introduction to Rodenhauser's and vom Baur's "Electric Furnaces in the Iron & Steel Industry," the German edition of which appeared in 1911, states that when the invention of the Stassano, Heroult and Kjellin furnaces first drew the attention of the iron industry "an important contributing factor was a report by Dr. Haanel, chief of a commission of experts sent by the Canadian Government to Europe to study the electric furnace."

Dr. Haanel has also devoted much attention to the utilisation of the peat deposits of Canada, and in general has adapted his knowledge of technical progress in Northern Europe to Canadian conditions, which are in many respects strikingly similar.

AGRICULTURAL IMPLEMENT INDUSTRY IN CANADA, DURING 1919.

Employs 10,500 Persons and Uses 126,000 Tons of Steel and Iron.

Agricultural implements with a selling value at the works of $36,703,943 were manufactured in Canadian plants during 1919, according to the preliminary report on this industry recently issued by the Dominion Bureau of Statistics. Total capital invested in the industry was $83,276,450, of which $77,693,500 was invested in Ontario. The statistics cover the operations of 86 plants distributed by Provinces as follows: Ontario 51, Quebec 20, Manitoba 7, Alberta 3, Saskatchewan 3 and Prince Edward Island 2. Classification under the item of capital invested show that $13,377,-642 was invested in land, buildings and fixtures, $7,-156,394 in machinery and tools, $34,521,554 in materials in hand, stocks in process and finished products on hand; $34,000 in fuel and miscellaneous supplies and $28,220,860 in trading and operating accounts.

The number of employees in the industry is given as 10,242 male and 566 female, and the total of salaries and wages was $11,858,013.

Fuel used during the year was valued at $721,801.

Raw materials having a cost value at the works of $16,520,146 were used. These are itemized as follows: Steel and steel castings, 65,843 tons, $5,577,067; iron and steel castings, 40,055 tons, $1,838,566; malleable iron, 20,769 tons, $1,226,917; lumber and timber, 42,986 M. feet, $2,051,030; all other materials used, $5,826,566.

C. V. CORLESS NOMINATED PRESIDENT C. I. M. & M.

Mr. C. V. Corless, General Manager and Director of the Mond Nickel Company of Coniston, Ont., has been nominated President of the Canadian Institute of Mining & Metallurgy, according to announcement in the January issue of the "Bulletin".

ELECTRIC WELDING

History and survey of electric welding methods concluding with research work by the writer

(Read at the Eighth General Professional Meeting, Halifax, October 13th, 1920, and reprinted by permission from the "Journal of the Engineering Institute of Canada).

FRED. H. WILLIAMS, A.M.E.I.C.

Electric Welding is one of the most useful of recent developments in the fabricating of iron, steel and other metals. It made great strides during the late war, when the necessity of rapid fabricating of materials, the repairing of broken parts and the building up of the worn surfaces of machinery of all kinds, were of such great importance.

The demands of labour for more money and less working hours are resulting in many industries turning to the Electric Welding process for help in keeping the costs of operating and manufacturing down to the lowest level possible.

Many articles on the Art of Electric Welding have been written by men in various callings of life and it would be somewhat presumptuous of the writer to attempt to cover more than one or two phases of this most interesting and useful art in the short time available. A general review of the history of welding and the development of the electrical portion of welding will probably be about all that can be reviewed from what has already been written, (in order that an understanding of welding may be had by the present meeting), without too much duplication.

The Encyclopaedia Britainica has a very good description of the progress of the art of welding and for those who wish a more detailed account, the writer would suggest a perusal of its columns. The following brief and rapid review will however give a general ideal of the most important features of this very interesting subject.

Welding (namely, the action of the verb "to weld,) is the same as "to well", to boil or spring up, the history of the word being to boil, to heat to a high degree, to beat heated iron, and has developed from the necessity of man requiring means of joining metals together other than the mechanical fastenings by bolts, rivets, clamps, hinges etc.

The following will give a comprehensive idea of the relation that the various methods of welding bear to one another:—

- Welding
  - Pressure
    - With the Forge
      - Scarf
      - Butt
      - Vee
    - Electric
      - Spot
      - Butt
      - Seam
  - Autogenous
    - Electric Arc
      - Carbon Electrode
        - With Metal Filling Rod
        - Without Metal Filling Rod
      - Metal Electrode
        - Bare Electrode
        - Slag Covered Electrode
        - Flux Covered Electrode
    - Gas Welding
      - Oxy-Acetylene
    - Thermit Welding

The steps by which this development has been brought to its present stage of perfection (some of which are still useful and of more or less importance commercially) may be briefly considered as follows:—

Pressure Welding

The process of uniting metallic surfaces by pressure exercised when they are in a semifluid condition, consists of heating the ends of the parts to be welded to a proper temperature and fusing them together by pressure, either by the smith's hammer and anvil, or, later, by the steam or air hammer, hydraulic press, etc. This is known as pressure welding. For successful welding care must be taken that the surfaces are made clean, and that the joints are rapidly brought together. Variations in the forms of this type of welding are many, depending upon the work in hand and

the practice of the blacksmith or the shop wherein the work is done. The most common terms applying to the welds made by pressure welding are 'Scarf', 'Butt', and 'Vee'.

Scarf Welding

It is styled 'Scarf' welding where the two ends are made diagonally flat to give more surface for the weld (the end being slightly convex to allow the dirt to be forced out of the interior of the weld, should any remain, when the pressure is applied and thus assure as nearly a perfect welded joint as possible). The ends, in this case as well as in the others, are upset to give sufficient metal after the weld has been made, to enable the smith to finish the welded part in proportion to the adjacent parts, giving the finished article a neat appearance and sufficient strength for its requirements. Further care has to be taken to see that the surfaces are clean, chemically viz., free from oxides; and mechanically viz., free from dirt that the weld may be thorough.

In the case of Scarf, Butt and Vee welds these two conditions are obtained, in the first instance by using fluxes of sand for wrought iron, and borax for steel (the flux forming a slag, which is forced from the joint upon the application of the pressure), in the second by using a clean hollow fire and brushing off, previous to joining, any particles of dirt that may adhere to the surfaces. Thoroughness in this respect should be rigidly applied in all welding.

Butt and Vee Welding

Butt and Vee welds are similar except that in the butt weld the surface is somewhat less than the scarf weld and the vee weld has more surface to be welded, involving the greater possibility of slag inclusions and requiring more care in preparing the end to be welded.

Temperature for welding is a most important factor, especially owing to the fact that each grade of iron or steel requires to be handled at a different temperature. In iron the ends may be melted, but in steel a low heat is required, that is, not over a moderate white heat must be used. Steel does not weld as readily as iron nor is the weld as reliable. Oxidation of the metal must be avoided as burnt metal cannot be welded.

As pressure welding proved limited in its uses, a further development was made, and welding without pressure resulted, (this is known as Autogenous Welding. In the first method, (pressure welding), a comparatively low heat and high pressure is required whereas in the second method, (autogenous welding), a comparatively high temperature and low or no pressure is necessary.

It may here be noted that while many new methods of welding have been developed, viz., Electric, Gas and Thermit, and great improvements resulting thereform, the heretofore described pressure welding is still much in use at the present time and while it is superseded in some of its uses by these new methods, it will without doubt retain much of its present usefulness and not, in time, become an antiquated process.

Pressure Welding (Electric)

In 1886 Elihu Thomson brought forward the process of resistance welding which is a form of pressure welding wherein electric current of low voltage is used to produce the heat required for the welding, and pressure either by hydraulic or some mechanical contrivance is brought to bear for pressing the rods, wires, plates etc. together. The current may run as high as 100,000 amperes and the voltage as low as two or three volts or even lower.

There are two types of this kind of welding, viz., "Butt" and "Spot", the latter may be extended into what is termed "Seam" welding, or a continuous series of spot welds.

The heavy current required for "Butt" and "Spot" welding or, what may be termed and is known as resistance welding, makes the use of short leads to the plates or points of contact necessary, especially when alternating current is used. This is overcome by making these leads part of the secondary winding of the welding transformer (Thomson).

Butt welding is extensively used at the present time in various lines of manufacture, in the making of wire hoops, rubber tires (wherein the centre is a wire core butt welded), the welding of rods etc.

Spot welding is also in use extensively in various places, for instance, plate welding where it is used in the place of rivets (in this it is sometimes made continuous, that is, the spot welds are so close together that it becomes one continuous weld, it is then known as "seam" welding). Fence and various wire fabrications are also accomplished by this method; spot welding of sheet metal articles of numerous shapes such as helmets, cooking utensils etc., is carried on to a very large extent commercially, enabling the production of many useful articles, and simplifying as well as cheapening the manufacture of the same.

In the case of armour plate, this method is used to anneal portions for cutting or drilling. The current is passed through the spot to be softened and the portion brought to a red heat, by reducing the current gradually, the surrounding metal retains its hardness while the spot under the terminals is softened.

The bonding of rails and the welding of various alloys are accomplished by this process of Elihu Thomson. The field is not yet fully developed and many possibilities remain to be developed and commercialized.

By means of a rotary converter and transformer for changing and reducing the high Direct Current to very low voltage Alternating Current, the spot welding process is used for welding the bonds to the rails for the return circuit of Direct Current Electric Railway Systems.

Autogenous Welding (Gas Welding, Oxy-Acetylene)

In 1820 the oxy-hydrogen blowpipe was used for producing "limelight", later to fuse platinum and was finally utilized in lead burning and various forms of welding. The oxy-hydrogen process of welding was improved subsequently by using acetylene in the place of hydrogen. With oxy-acetylene and its higher temperature, a larger field was opened up. Cutting of metal parts by its flame is one of the uses of the oxy-acetylene flame. Improvement in the design of the apparatus concerned therewith has resulted in the use of this method of welding in almost every branch of metal work at the present day. There is considerable competition between it and the electric process, and so close has this contest between these two methods become, that it would be unfair to give either the position of leaders. The rapid progress of the art of electric welding, as in the last few years, will necessitate on the part of the promoters of the oxy-ace-

tylene process, much study and expenditure of energy if they is to keep even with the electric process.

Other gases have been used but none have as yet approached the oxy-acetylene in usefulness.

Autogenous Welding (Thermit)

The next form of welding originated in 1894 when C. Vautin found that when finely divided aluminium was mixed with such compounds as metallic chlorides, oxides, sulphides etc. and ignited, exceedingly high temperatures resulted from the rapid oxidation of the aluminium, about 3000 degrees C. being obtained.

It remained, however, for H. Goldschmidt to utilize this discovery in a practical way. He welded two bars of steel by combining molten iron, the two ends of the bars thereby producing a solid joint. The heat for this joint, or weld, was obtained by the rapid oxidation of finely divided aluminum and iron oxide. This process was termed "Thermit Welding".

Pure metals such as iron, chromium, manganese, etc. were obtained from their oxides etc. by this method of reduction, and made use of in welding.

Thermit for welding iron and steel is made by mixing iron oxide with finely divided aluminum in a crucible lined with magnesia and having a cover to retain the molten mass during reaction, until poured. The molten mass, after the reaction, consists of two layers, the upper oxide of alumina, or corundum, and the bottom layer practically pure iron. The position of the molten iron relative to the slag necessitates the pouring of the iron through the bottom of the mould that surrounds the ends to be welded. Steel punchings are sometimes added to the charge before the reaction takes place, to absorb some of the excessive heat and to reduce the amount of iron oxide that otherwise would be required to fill the mould.

The mould is prepared by building up a wax form to the shape of the finished weld around the ends to be welded and, surrounding this with the material used for building up the mould. The wax is then melted, withdrawn and weighed, in order that the required charge for the work which bears a certain relation of this may be calculated. Magnesium ribbon or wire is used to ignite the charge.

Care must be taken to prevent slag filling the mould, as would happen by premature pouring, and also to pour the metal sufficiently hot to melt the ends of the pieces to be welded. Preheating is used on large welds to avoid chilling of the fluid metal which would prevent the uniting of the ends and the molten metal.

This method of welding has been used to a great extent in welding large castings and girders, as well as smaller parts such as rails, bonds on rails, rims of fly-wheels, spoke and hubs of locomotive drivers etc., engine frames etc. It is much used at the present day, and where failures in its use occur, it is generally due to some foreign cause, miscalculation of the charge etc., or its use in places where a successful weld could not be obtained owing to the faulty design of the casting to be welded. It must be remembered that the resultant weld is cast metal and should be considered as such in designing its use.

Autogenous Welding (Electric Arc)

In 1874 Werdermann suggested the use of the flame gases of the electric arc blown upon the work by air or otherwise. This was later developed by Zerener, who utilized the effect of a magnet in blowing the flame of the arc upon the work, puddling the metal where the welding was being done. This meant that the method could be used only in working downward, no vertical or overhead work could be accomplished in this way. This method is now practically abandoned.

Arc welding really had its start in 1881 when de Meriteus used it for welding parts of storage batteries together. The metal parts (lead) were laid on a support or plate which was made the positive side of the arc and a carbon was used as the negative pole, the arc being established by touching and breaking the contact, the heat of the arc melting the ends or edges of these lead pieces and welding them together by the fusion of the same.

The next step in electric welding was by Bernardos and Olszewski who used the carbon as the positive and the work as the negative. A metal rod was used for filling in the necessary additional metal for making the weld, the arc being drawn long enough to allow the rod to be gradually fed into the flame of the arc by hand, the heat of the arc melting both it and the ends of the parts to be welded. The whole mass was then allowed to cool slowly, thus completing the weld. This form of electric welding is not completely satisfactory owing to the very high heat of the arc setting up strains that, in cast iron especially, are very dangerous; also a very much higher current is required, seldom less than 150 amperes and often 500 or 600 amperes.

The difficulties in using the carbon arc arise from the above causes and in addition to these, many kinds of work are impossible of accomplishment, due to the impurities of the carbon being deposited in the weld along with the metal. In the case of cast iron these result in a very hard brittle metal, impossible to machine.

An improvement over this method was developed by Slavianoff when he utilized the metal rod not only to provide the metal for filling or building up the weld, but also as the means to start and hold the arc. The metal rod may be either the negative, or the positive side of the arc. Later, the use of the rod as the negative was generally adopted, unless the work was very thin, in which case the reverse would enable the operator to keep the heat on the work low enough to prevent it from becoming overmelted.

In making the work positive the heat imparted to it is much higher, in proportion to the energy delivered, than when the work is negative. This is due to the comparatively recently noted fact that the positive side of the arc is the hotter.

A longer arc is required for the carbon electrode than for the metallic, it being in some instances as much as 3 inches. The voltage necessary to maintain the arc is proportionately higher and generally is about 150 volts.

Returning to the carbon arc welding process, this method, attributed to Bernardos, was the first to be used commercially in the welding of metals on a small scale, in about 1888, and shortly after Slavianoff brought forth the use of the metallic electrode as a process of great possibilities.

Rapid development in the art of arc welding, however, has been made in the last few years, and the greatest strides occurred during the last war, when speed in everything was so completely the order of the day. The development made then has proved so completely the advantages of arc welding that it is now being used in almost every plant of any size in Canada and the United States, and in every kind of

iron and steel fabrication, as a glance at the following list of some of the present day applications of the electric arc for welding and cutting will illustrate:—

Applications of Electric Arc Welding

Steel Mills:—
- Clearing the rolls of cobbles.
- Filling in steel forgings.
- Building up wobblers.

Foundries:—
- Cutting on risers and sinkheads.
- Repairing casks.

Machine Shops:—
- Filling up blowholes in partially machined castings.
- Repairing broken castings.
- Building up worn parts of crank pins.
- Welding broken crank shafts.
- Welding tool steel to mild steel shanks for lathe and other machine tools.
- Building up collars, or replacing metal that has been machined off by mistake.

Steam Railroad Shops:—
- Fabricating the greater part of fireboxes.
- Repairs to fireboxes, boiler and other plate parts.
- Welding in flues to the flue-sheet.
- Repairing engine frames, cylinders, crank pins etc.
- Building up slide-bars, guides, link gear parts, crank pins and various parts that are worn so much that it is inadvisable to shim them up, or compensate in other ways.

Electric Railways:—
- Fabricating gear cases.
- Repairing motor frames and armature shafts.
- Building up worn parts on motor frames, armature shafts, brake-beams and truck parts.
- Repairing frogs, crossings, turnouts and building up low rails at joints where wear is especially prevalent.

Ship Yards:—
- Repairing marine boilers.
- Welding tanks.
- Welding angle irons, handles, catches and numerous small fittings to the ship's plate.
- Welding broken parts of all kinds.

Electric Arc Welding today is principally by means of the metal electrode, and the welding plant may use either alternating or direct current for the welding.

The alternating current apparatus is a transformer with the primary winding suitably designed for the line voltage where it is to be used, and the secondary to give about 90 to 100 volts on open circuit and 20 to 30 volts on short circuit or when the arc is drawn.

The direct current apparatus is of many kinds. In general, however, the manufacturers are more or less at one in the principal features required for electric welding, through they may differ somewhat as to design.

The first welding outfits used were of the resistance type. In this a resistance was used to control the current, the voltage remaining constant. Taps in the resistance enabled the use of various sizes of electrodes. The regulation was somewhat crude as the drop across the resistance varied with the current. Extreme variations were checked. The regulation of the voltage across the arc and the current through it give approximately a constant rate of heating.

The next step was the use of D. C. generators, in which various arrangements were used in design to obtain a suitable regulation of the arc, and many of these are being used with satisfactory results today. These D. C. generators may be motor or belt driven and, in cases where electric power is not at hand, a gasoline or steam engine may be used for motive power.

It is a question in some minds as to which is the better current to use, alternating or direct. Both have advantages and disadvantages, and it seems that, for the present, the direct current is the more patronized. The writer has the idea that a mere visual examination of weld, or their test by pulling to the breaking point, without microscopic examination results in opinions of small advantage, and that a continued study of welds in actual work, with the microscope, will be the only methods of determining the better of these two currents, for welding purposes.

The alternating current welding transformer is a newer development than the direct current generator and it has many advantages, viz:—No moving parts, and much smaller size in comparison to the current output. It has one great disadvantage, viz. a very low power factor, in some cases being as low as .35.

There are many types of D.C. welding sets and a few types of A.C. welding sets. The general method of procedure in welding is as follows:—an arc is established with the metal electrode, and as the rod is vaporized or melted by the arc, it is brought nearer the work and is kept close enough to maintain the arc until the whole rod is fed into the weld. It is kept moving in a circular motion, puddling the molten metal deposited by the arc, in order to obtain a neat weld, free from impurities. This operation and the neat appearance of the weld, as well as a good, clean, sound deposit, depends much upon the operator. Care should be taken to get standard reliable machines and the best welding wire. It will be shown by some of the microphotographs that the operator, welding apparatus, and wire may be the best and still a poor weld be the result, due to the poor material that is being welded.

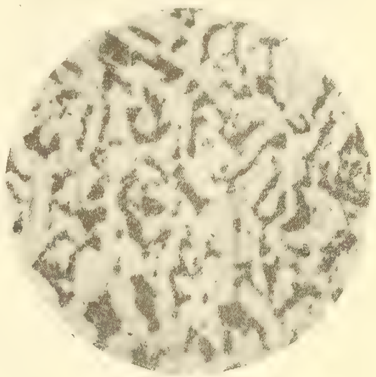


Figure 1

Figure 1.—This is a cross section of a piece of boiler plate, the photograph was taken about one inch from the weld and is about 20 per cent carbon steel. The light area is the ferrite and the dark is the pearlite. There is no apparent indication of ghost lines or impurities in this steel. The weld is shown in a following photograph and is very good, showing no impurities in the parent metal or the deposited metal. The next photograph shows the change in the structure due to the heat of the arc. Magnification 100x.

The electrode for the general run of work may be Swedish or pure iron rods, sizes 3-32 in., 1-8 in., 5-32 in. and 3-16 in. round, and 14 in. to 18 in. in length.

The advantages of electric welding over gas welding are that in the former, the heat is kept low and localized and, in most cases, the preheating of any part of the work is unnecessary, whereas in gas welding, the adjacent parts are preheated by the gas before the weld can be made. The extreme heat from the gas affects the structure of the metal several inches back from the weld, and often results in a course crystaline structure of the parent metal.

The art of electric welding is now just beginning to be one of the indispensable factors in the iron and steel industry. It is to be most valuable to those who will value it most and who endeavour to find out why failures occur.

It is possible that the following photos will be of some service to those who are following the same line of research that the writer has undertaken, as they are intended to show that the material to be welded is an important factor.

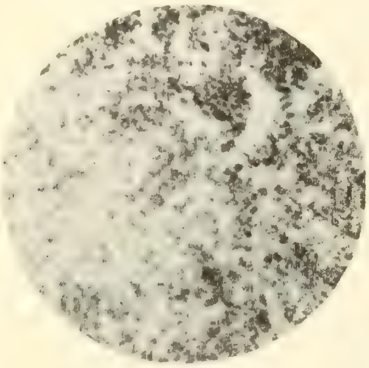


Figure 2

Figure 2.—The structure shown in this photograph is that of the annealed portion of a piece of boiler plate taken between the weld and the original metal. In the weld, the area affected by the heat of the arc extended ¾-in. from the line of the weld and graded off on the one hand to the original metal and on the other hand to a more refined structure close to the weld, both of these stages are illustrated in this paper. This weld was 70 per cent bright fracture and 30 per cent dull fracture when broken. The efficiency of the weld over the original was 89 per cent. There were no apparent ghost lines in the best portion of the plate and they appeared very faintly in the remaining portion. It would thus be apparent that a very slight appearance of the ghost lines would cause poor welds. Further investigation of these lines is being conducted by the writer. Magnification 100x.

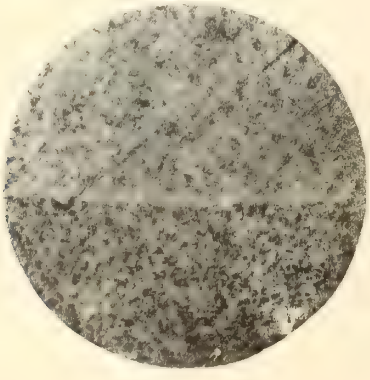


Figure 3

Figure 3.—This photograph shows a good weld, the light side is the deposited metal and is of good structure. The dark is the parent metal and is in a more refined state than it was originally. The comparatively coarse structure of the original plate is first annealed by the heat of the electric arc as is shown in a preceeding photograph, then as it cools off the portion near the weld becomes more refined and the line of the weld is very pure iron. The line of the weld is the narrow line diagonally across the photo. This weld was very strong and was 89 per cent efficient as compared with the plate. When tested the break occurred through the weld and the fracture was clean and bright for about 70 per cent of the area. Magnification 100x.

Figure 4.—This shows a cross section of a weld at the edge of the bead showing that there was not a complete weld at this point. The welded metal

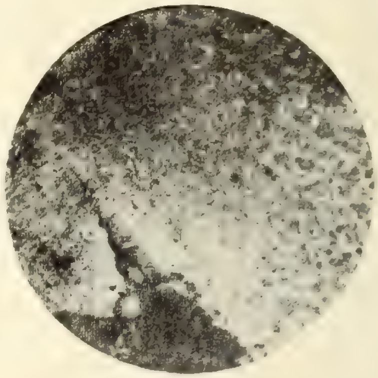


Figure 4

shows slag of some kind separating the deposited metal and the original plate. This is probably an oixde of iron due to the plate not being properly when the weld was made. The microphotograph cleaned and to an improper position of the electrode shows up what could not be seen by the naked eye and gives a clear idea of what is taking place and is a means whereby the welder can be shown where he is going wrong. The change in the structure of the plate from the original to the structureless metal at the weld quite different from that shown in a preceding photo. To determine whether there is a fault in this result would require some time and stud which if not already done, will be, to the advantage of all concerned. This would give an idea as to whether the welder or the material is at fault. Magnification 50x.

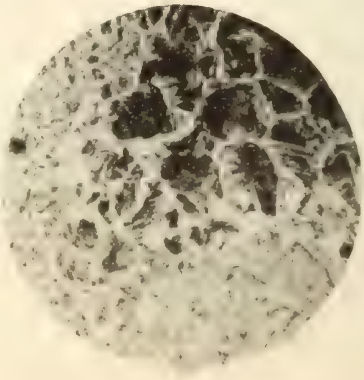


Figure 5

Figure 5.—This photograph is a weld made with the electric arc on ½-in. boiler plate, the close grain metal on the two sides of the point of coarse grain crystals is the deposited metal, the point is the parent metal and is not strong due to its coarse grain. A break would occur across this point providing that the welded metal was weak. The electrode used was "Quasi Arc" and the heat from the weld produced many grains of manganese silicate in the deposited metal weakening the same so that the combination of the course structure of the parent metal and the poor deposited metal gave a very low tensile strength, viz. 28,000 lbs. per sq. inch when tested. Magnification 100x.

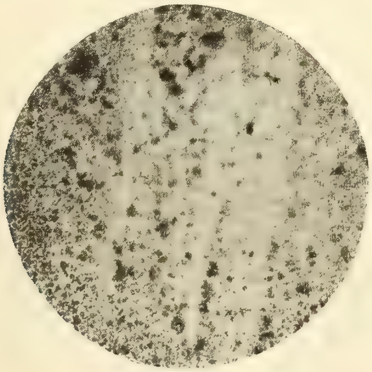


Figure 6

Figure 6.—This is a microphotograph of the ghost-lines in a piece of ½-in. boiler plate. These lines occur in the centre of the plate and extend to within about ⅛-in. of either surface of the plate. The occurrence of these lines depends upon the quality of the plate and the location of the same in the section of the steel billet when rolled. A few spots (dark) show up in this photograph, but when the plate is subjected to a high heat the spots increase in number and size. In electric welding they extend into the welded metal and are the cause of much defective welding that is often attributed to other causes than this, the right one. The writer has found that in welding two plates together end to end, the effect the heat from the electric arc changes these ghost lines into dark spots to a depth of at least ⅛-in. and that the impurities from the molten portion of the plate extends into the deposited metal quite extensively and forms a sort of chain along which the line of break can take place providing no weaker link is offered. Several examples of the above statements are included in the following pages. Magnification 50x.

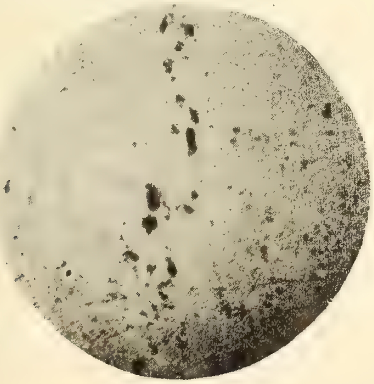


Figure 6A

Figure 6*a*.—This shows the effect of the heat of the electric arc in electric welding upon the ghost lines in boiler plate. This line of dark spots extends along the location of the ghost lines about ⅛-in. back from the line of weld and vanishes in the ghost line itself. These dark spots are a combination of manganese, silicon and iron; they are very brittle and therefore not satisfactory constituents to be included in the weld. The writer is including a microphotograph (Fig. 6*b*) showing the line of a fracture in a weld along a series of these spots, very clearly indicating that these form a constant source of weakness in welding, and that care should be taken whenever it is possible to avoid designing welds that assist the formation of these spots. It will be noticed that some of these spots are composed of two colours, the lighter of which is a sulphide of either manganese or iron or of both; this sulphide is ductile and does not effect the deposited metal as the silicate. The formation of these spots clearly indicates their composition, viz., the varying size of each in the group shows that they are not alumina spots which are small and even in size. Magnification 50x.

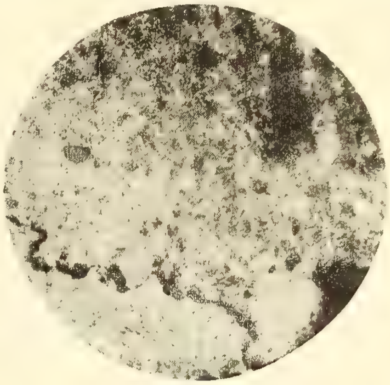


Figure 6B

Figure 6*b*.—This shows a section through a tube and tube sheet, that to visual examination gave no indications that any break occurred in the weld during tensile stress. It will be noted that the thin line of rupture zig-zagged along the line of least resistance viz., the irregular row of silicate inclusions showing that the strength of the portions of silicate are the weak points in a weld. This portion of the break is in the deposited metal and runs along the edge of the original plate near the end where a mixture of silicate and sulphite occurs. The coarse area to the right is the original plate annealed by the heat. The light gray spot near the top of the photograph is a

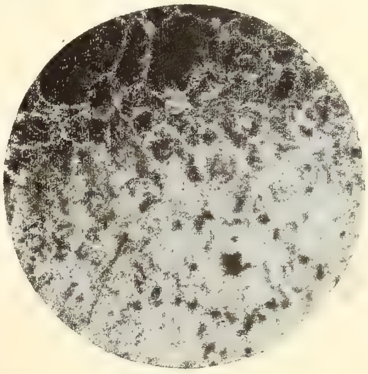


Figure 7

spot of sulphide, this, together with the silicate, originates in the ghost lines of the tube sheet. Magnification 100x.

Figure 7.—This photograph show the silicates in the weld and how they are arranged so as to aid in a rupture should a strain be put on the metal. The line of weld is shown in the lower part of the photograph at the right. The original plate was ½ in. boiler plate and the electrode was the "Quasi Arc" mild steel. Magnification 100x.

Figure 8

Figure 8.—Showing one method of welding a boiler tube in the tube sheet. The tube extends through the sheet ⅛-in. and is welded. Considerable care must be taken in making this weld as the plate and surface of the tube must be perfectly clean in order to ensure a good weld. This method is easily executed and is sufficiently strong enough for the service required of it. The disadvantage is that the flames and hot gases are obstructed from entering the tube, also on account of the ends projecting beyond the tube sheet they are subjected to the flame and liable to rapid deterioration from the same. Tensile tests on this form of welding have in cases shown that the weld was stronger than the tube. The line of breaking is sometimes through the tube but generally the tube shears along the weld close to the tube surface. Magnification 5x.

Figure 9

Figure 9.—This photograph shows front view of a tube welded into a tube-sheet after the same had been tested. The test gave a good tensile strength and this would appear to be a good method of welding. The tube and sheet were chamfered after the tube was rolled into place and the weld made on the beveled edge on both the tube and the sheet. The plate used was ½-in. boiler plate and as the weld was in the region of the ghost line that have been described herein it would be doubtful whether the percentage of welds could be relied upon. The writer has taken photos of the weld in this type of weld and has included a typical case in this paper. They all indicate that this is not as satisfactory a method as when the tube is welded to the outer ⅛-in. of the plate. It will be noticed that but a slight portion of the weld fractured and that where it did that the structure of the break was full of defects. Considerable portion of the weld gave way at the junction of the two metals and showed a poor weld, there were a lot of impurities which prevented a good weld. This is the result of the impurities in the plate and would be overcome if the weld was made in the proper place. The other way of overcoming this fault is to see that the very best plate be used. It must, however, be free from these ghost lines that cause the trouble. Magnification .5x.

Figure 10

Figure 10.—This is a tube welded into a tube sheet in a way to avoid the effects of the ghost lines that are prevalent in ½-in. boiler plate. The sheet is drilled for the tubes and chamfered about ⅛-in. deep, the tube rolled in, cut off even with the face of the plate and turned over with a suitable beading tool. The tube is not beaded as is the usual practice and the edges are left as nearby square as possible. The weld is then made by welding the end of the tube to the sheet, filling the vee made by the chamfer and the end of the tube. It will be noted that the weld takes place without the range of the centre of the ½-in. plate and thus clear of the ghost line infected centre of the plate. The tubes welded thus give strength, a nearby flush of plate and a clear entrance for the gases to enter the tube. Tests show that a good weld is obtained and that the tube shears first, the weld for the most part does not give away as it does in other cases. Magnification .5x.

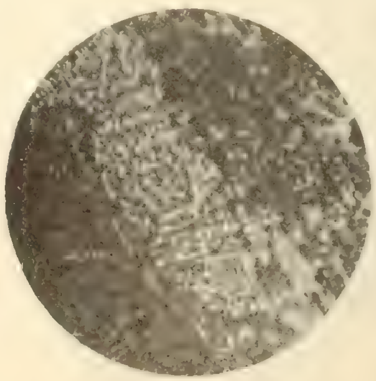


Figure 11

Figure 11.—This is a photograph of a cast iron weld with a pure iron electrode with the electric arc and gives a clear idea of the structure that will always be found in a weld of this kind. The white lace work through the centre is a bank of cementite made by the uniting pure iron with an impure (high carbon) iron; this is brittle, has a strength of about 5,000 pounds per square inch, a very low strength even for a cast iron weld. The deposited metal at the top is similarly to the ordinary deposit from a pure electrode, the bottom is the cast iron parent metal. Magnification 75x.

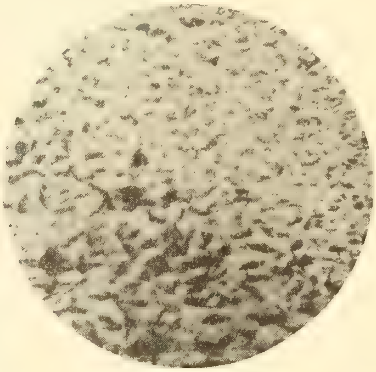


Figure 12

Figure 12.—This is a photograph of a cast iron weld made with the electrcic arc with a cast iron electrode. The dark portion of the photo is the parent metal and it will be seen that it is not as uniform a structure as the deposited metal, also that the deposited metal is nearly a pure iron deposit that the graphite (dark areas) are small and not closely connected. This weld is easily machined and has a good tensile strength. No preheating nor after heating was required to get these results. Magnification 100x.

"SPILLING THE BEANS."

Canadian politicians are sometimes accused of personalities and vituperation, but they rarely rise to the pitch of the "Australian & Industrial Standard" from whose editorial columns the following gem is taken. The funny part is that the Australian paper mentioned is out-and-out for the protection of Australian industries by tariffs.

> "The is something execrable and nasty in the make up of us all. No man lives but has a spice of the beast in his heart. But why gratuitously parade it — as the boot manufacturers did recently? Protection made them. It lifted them up from poverty to greatness. What right, then, have they to deny a similar opportunity to their brethren—the tanners? If they, the bootmakers, succeeded under Protection, in making the best boots in the world, why doubt that the tanners, under Protection, can and will make the best leather in the world? But we need not labour the subject. Meanness such as the boot manufacturers have displayed is certain to meet with its just and proper reward. The Government can be trusted to treat their representations with due contempt, and meanwhile the sordid and shameful exhibition they made of themselves may serve the useful purpose of deterring other protectionist hybrids from letting their particular beasts out of the cupboard."

PRODUCTION OF STEEL IN CANADA DURING THE FIRST NINE MONTHS OF 1920.

The total production of steel (including ingots and direct steel castings) in Canada during the first nine months of 1920 according to statistics collected by the Mines Branch of the Department of Mines, Ottawa, was 945,282 short tons, or an average of 105,931 tons per month as compared with a total production during the corresponding period in 1919 of 770,053 tons and an average monthly production throughout the whole of 1919 of 86,157 tons.

The production of steel during the nine months included: 901,188 tons of ingots and 44,094 tons of direct castings. The production in electric furnaces was 18,323 tons and in open-hearth, converter, crucible, or other furnaces 926,959 tons.

MONTHLY PRODUCTION OF STEEL IN CANADA.
(Including Ingots and Direct Castings).
(In Short Tons).

	1916.	1917.	1918.	1919.	1920.
January	....	130,991	145,808	120,297	102,709
February	....	120,674	138,975	100,531	94,245
March	589,553	152,420	158,234	111,793	109,027
April	....	139,734	166,612	83,445	103,578
May	....	155,411	174,275	77,146	100,965
June	....	137,161	165,973	76,185	101,935
July	100,817	139,222	165,022	73,536	105,394
August	107,273	145,934	170,495	60,226	117,460
September	113,411	149,000	166,725	66,894	110,369
October	123,469	161,297	184,115	73,716	
November	124,431	158,122	129,255	92,328	
December	116,265	155,967	117,965	97,789	
Average Monthly	106,268	145,494	156,954	86,157	105,931

PRODUCTION OF PIG IRON IN CANADA DURING THE FIRST NINE MONTHS OF 1920.

The total production of pig-iron in Canada during the first nine months of 1920, according to statistics collected by the Mines Branch of the Department of Mines, Ottawa, was 806,488 short tons (800,608 tons made in blast furnaces and 5,880 tons made in electric furnaces from scrap steel) as compared with a production during the first nine months of 1919 of 710,114 short tons. The average monthly production of pig iron during the first nine months of 1920 was 89,610 tons as compared with an average monthly production throughout 1919 of 76,482 tons.

The blast furnace plants active during the first nine months were those at Sydney and North Sydney, N.S. Hamilton, Port Colborne, and Sault Ste. Marie, Ontario.

The blast furnace plants at Midland, Parry Sound, Deseronto, and Port Arthur, Ontario were idle throughout the period.

At the end of September 10 stacks were active and 8 idle.

Pig iron was made from scrap iron and steel at four electric furnace plants located at Hull, Montreal and Shawinigan Falls, Quebec, and Orillia, Ontario.

The monthly production of pig-iron in short tons since 1916 has been as follows:—

	1916.	1917.	1918.	1919.	1920.*
January	....	89,187	74,239	103,963	81,494
February	....	83,801	78,507	86,840	70,864
March	562,097	103,789	96,848	91,286	77,155
April	....	100,564	104,331	93,359	86,303
May	....	108,891	104,867	83,059	97,593
June	....	99,998	103,037	66,470	89,258
July	92,012	93,499	109,723	60,927	94,417
August	87,864	100,727	96,164	67,404	104,482
September	102,744	100,690	95,102	56,806	104,922
October	113,608	103,277	106,962	56,049	
November	105,496	97,905	106,585	73,092	
December	106,496	87,152	119,186	78,526	
	1,169,257	1,170,480	1,195,551	917,781	
Average Monthly	97,438	97,540	99,629	76,482	89,610